AN ADOPTION OF MARPOL 73/78 FOR MANAGING SHIP-GENERATED GARBAGE IN LAEM CHABANG PORT : A CASE OF SHIPPING COLLABORATIONS

Acting Sub Lieutenant Chalermpong Senarak

A Dissertation Submitted in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy Program in Logistics Management
(Interdisciplinary Program)
Graduate School
Chulalongkorn University
Academic Year 2016

การรับอนุสัญญาระหว่างประเทศว่าด้วยการป้องกันมลพิษจากเรือเพื่อการจัดการขยะจากเรือในท่าเรือแหลมฉบัง : กรณีความร่วมมือของธุรกิจการขนส่งทางเรือ

ว่าที่เรือตรีเฉลิมพงษ์ เสนารักษ์

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรดุษฎีบัณฑิต
สาขาวิชาการจัดการด้านโลจิสติกส์ (สหสาขาวิชา)
บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2559

Thesis Title	AN ADOPTION OF MARPOL 73/78 FOR MANAGING SHIP-GENERATED GARBAGE IN LAEM CHABANG PORT : A CASE OF SHIPPING COLLABORATIONS
By	Acting Sub Lieutenant Chalermpong Senarak
Field of Study	Logistics Management
Thesis Advisor	Professor Kamonchanok Suthiwartnarueput, Ph.D.
Thesis Co-Advisor	Associate Professor Pongsa Pornchaiwiseskul, Ph.D.

Accepted by the Graduate School, Chulalongkorn University in Partial Fulfillment of the Requirements for the Doctoral Degree

.....Dean of the Graduate School
(Associate Professor Sunait Chutintaranond, Ph.D.)

THESIS COMMITTEE

.....Chairman
(Associate Professor Rahuth Rodjanapradied, Ph.D.)
.....Thesis Advisor
(Professor Kamonchanok Suthiwartnarueput, Ph.D.)
.....Thesis Co-Advisor
(Associate Professor Pongsa Pornchaiwiseskul, Ph.D.)
.....Examiner
(Krisana Visamitanan, D.Eng.)
.....Examiner
(Assistant Professor Tartat Mokkhamakkul, Ph.D.)
.....External Examiner
(Associate Professor Supoj Chawawiwat)

เฉลิมพงษ์ เสนารักษ์ : การรับอนุสัญญาระหว่างประเทศว่าด้วยการป้องกันมลพิษจากเรือเพื่อการจัดการขยะจากเรือในท่าเรือแหลมฉบัง : กรณีความร่วมมือของธุรกิจการขนส่งทางเรือ (AN ADOPTION OF MARPOL 73/78 FOR MANAGING SHIP-GENERATED GARBAGE IN LAEM CHABANG PORT : A CASE OF SHIPPING COLLABORATIONS) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ศ. ดร. กมลชนก สุทธิวาทนฤพุฒิ, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม: รศ. ดร. พงศา พรชัยวิเศษกุล, 213 หน้า.

การทิ้งขยะจากเรือสินค้าเป็นสาเหตุของมลพิษทางทะเลที่สำคัญของโลก ดังนั้น องค์การทางทะเลระหว่างประเทศจึงได้วางหลักการให้ท่าเรือและท่าเทียบเรือต้องจัดให้มีอุปกรณ์และสิ่งอำนวยความสะดวกให้เพียงพอต่อความต้องการในการทิ้งขยะจากเรือ โดยไม่ก่อให้เกิดความล่าช้าต่อการปฏิบัติการเรือ อย่างไรก็ตาม การปฏิบัติตามกฎหมายดังกล่าวไม่ใช่ปัจจัยที่มีผลต่อการตัดสินใจทิ้งขยะที่ท่าเรือของผู้ขนส่งทางทะเลเพียงอย่างเดียว แต่ทว่ายังมีปัจจัยที่มีอิทธิพลอื่นๆ อีกเป็นจำนวนมาก ดังนั้นงานวิจัยนี้จึงมุ่งเน้นการสร้างองค์ความรู้ใหม่ผ่านวัตถุประสงค์การศึกษา 4 ประการ คือ 1) เพื่อสำรวจระดับของผลการให้บริการอุปกรณ์รองรับขยะของท่าเรือแหลมฉบัง 2) เพื่อวิเคราะห์ผลกระทบของปัจจัยที่มีผลต่อการนำขยะมาทิ้งที่ท่าเรือแหลมฉบังของผู้ขนส่งทางทะเล 3) เพื่อวิเคราะห์ความสัมพันธ์ของความร่วมมือระหว่างท่าเรือแหลมฉบังและผู้ขนส่งทางทะเล และเสนอแนวทางเพื่อเพิ่มความร่วมมือในการจัดการขยะจากเรือ และ 4) เพื่อวิเคราะห์ประโยชน์ที่คาดว่าจะได้รับจากความร่วมมือระหว่างท่าเรือแหลมฉบังและผู้ขนส่งทางทะเล ทั้งนี้ ผู้วิจัยใช้แบบสอบถามเก็บข้อมูลจากผู้ขนส่งทางทะเล และตัวแทนสายเรือรวมทั้งสิ้น 148 บริษัท เป็นเวลานาน 6 เดือน ผลปรากฏว่า มีแบบสอบถามที่ถูกส่งกลับและสมบูรณ์ทั้งสิ้น 127 ฉบับ คิดเป็น 85.81% การวิเคราะห์ข้อมูลในวัตถุประสงค์ที่ 1, 2 และ 4 ใช้การวิเคราะห์ความแปรปรวนหลายตัวแปร ส่วนการวิเคราะห์ข้อมูลในวัตถุประสงค์ที่ 3 ใช้ตัวแบบการถดถอยเชิงอันดับ

ผลจากการวิเคราะห์ พบว่า 1) ระดับของความถี่ในการใช้บริการท่าเรือแหลมฉบังของผู้ขนส่งทางทะเล 2) สัญชาติของบริษัทขนส่งทางทะเล และ 3) ประเภทของเรือของผู้ขนส่งทางทะเล นั้น มีอิทธิพลต่อความแตกต่างของทัศนคติของผู้ขนส่งทางทะเลที่มีต่อ 1) ระดับของผลการให้บริการอุปกรณ์รองรับขยะของท่าเรือแหลมฉบัง และ 2) ปัจจัยที่มีผลต่อการนำขยะมาทิ้งที่ท่าเรือแหลมฉบัง ในการนี้ ผู้ขนส่งทางทะเลประเมินว่า ท่าเรือแหลมฉบังจัดให้มีอุปกรณ์เพื่อรับรองขยะอันตรายจากเรืออย่างเพียงพอ ให้บริการตรงเวลา และมีการติดต่อเพื่อขอใช้บริการเก็บขยะที่สะดวกสบาย แต่ยังมีบางกิจกรรมที่ยังไม่สอดคล้องกับข้อกำหนดในบทบัญญัติของอนุสัญญาระหว่างประเทศว่าด้วยการป้องกันมลพิษจากเรือ เพื่อใช้ในการแก้ปัญหาในการให้บริการเก็บขยะของท่าเรือแหลมฉบัง ยกระดับการดำเนินงานของกรมเจ้าท่าในการป้องกันมลพิษจากขยะจากเรือ และเพิ่มความร่วมมือระหว่างท่าเรือแหลมฉบังและผู้ขนส่งทางทะเล

สาขาวิชา การจัดการด้านโลจิสติกส์ ลายมือชื่อนิสิต .....

ปีการศึกษา 2559 ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

ลายมือชื่อ อ.ที่ปรึกษาร่วม .....

5787765920 : MAJOR LOGISTICS MANAGEMENT
KEYWORDS: SHIP-GENERATED GARBAGE / MARINE POLLUTION PREVENTION / COLLABORATIONS / LAEM CHABANG PORT / SHIPPING COMPANIES / MARPOL 73/78

CHALERMPONG SENARAK: AN ADOPTION OF MARPOL 73/78 FOR MANAGING SHIP-GENERATED GARBAGE IN LAEM CHABANG PORT : A CASE OF SHIPPING COLLABORATIONS. ADVISOR: PROF. KAMONCHANOK SUTHIWARTNARUEPUT, Ph.D., CO-ADVISOR: ASSOC. PROF. PONGSA PORNCHAIWISESKUL, Ph.D., 213 pp.

Ship-generated garbage is harmful to aquatic creatures and ecosystems. To prevent the marine environment from this pollutant, the adequate provision of garbage reception facility (GRF) in seaports is critical. This study contributes the practitioner and the literature by developing collaboration concepts for managing it through four objectives: 1) to survey the levels of existing performances in providing GRF of LCP; 2) to analyze the impact of factors on the motivations of shipping companies in delivering their ship-generated garbage at the GRF of LCP; 3) to analyze the relationship of collaborations between LCP and the shipping companies and suggest how to boost up the collaborations; and 4) to analyze the benefits expected to gain from the collaborations between LCP and the shipping companies. To analyze the data, the multivariate analysis of variance was used in objective 1, 2 and 4 while the ordinal regression model was adopted in objective 3. The data was gathered through the adoption of the questionnaires which were sent to 148 shipping firms. The complete questionnaires were returned from 127 shipping firms with the response rate of 85.81%.

The analysis indicates that 1) the frequency of ship berthing at LCP per year, 2) the nationality of the shipping firms and 3) the types of ships operated by the shipping firms, influence on the differences of attitude of ship operators as follow: 1) the performances in providing GRF of LCP and 2) the motivations in delivering their ship-generated garbage at the GRF of LCP. The findings enable us to identify 1) the failure of LCP in maintaining performances required by MARPOL 73/78 and 2) the deficiency in enforcing the national laws of Marine Department of Thailand. Finally, three collaboration models verified by ship operators are developed to alleviate the existing challenges and enhance the marine pollution prevention from ship-generated garbage at LCP.

Field of Study: Logistics Management Student's Signature .....
Academic Year: 2016 Advisor's Signature .....
Co-Advisor's Signature .....

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my thesis advisor Prof. Kamonchanok Suthiwartnarueput and thesis co-advisor Assoc. Prof. Pongsa Pornchaiwiseskul for providing me with the opportunity to complete my Ph.D. thesis at Chulalongkorn University. I am very grateful for their patience, motivation, enthusiasm, and immense knowledge in maritime transportation, port management and statistics that altogether make them the great advisors. I also would like to thank my thesis committees: Assoc. Prof. Rahuth Rodjanapradied, Dr. Krisana Visamitanan, Asst. Prof. Tartat Mokkhamakkul, and Assoc. Prof. Supoj Chawawiwat, who considerably guided and helped me. I wholeheartedly thank Mrs. Wilairat Senarak, my lovely mum, who always encourages and teaches me in every step I take. I absolutely thank Assoc. Prof. Boonpoom Senarak, my dad, for inspiring me to pursue my doctoral degree at Chulalongkorn University. I also thank my cute sisters Miss Daranee Senarak and Mrs. Penpan Senarak, who always guide me on how to obtain good grades and provide spiritual supports. They have been the source of love and energy ever since. I truly thank Commander Marut Chatpram, my open-handed brother, who has largely assisted and encouraged me to attain my Ph.D. over the past many years.

I honestly thank Admiral Supit Umnouy and the committee of the Faculty of International Maritime Studies (IMS) for offering me the Ph.D. scholarship. I am very grateful for the fund, which allowed me to pursue my doctoral degree. I praise the enormous amount of help from the staff at IMS, especially Mr. Worawut Poma, Mrs. Orawan Mokkhavas, Dr. Sarinya Sanitwong_na_Ayutthaya and Mrs. Methisaree Kluanmek. Your merit and friendship are irreplaceable. Thank you all of my students at IMS, who heavily supported my teaching at Kasetsart University, while I was studying at Chulalongkorn University. I sincerely thank for the recommendation and assistance from Captain Wissaurth Kongutaikul. He is the first person who enabled me to initiate this research and always guided me with my Ph.D. thesis through these years. I also thank for the considerable assistance in providing the valuable information from the PAT staff and also all respondents for completing the questionnaire survey.

CONTENTS

Page

Page

Page

Page

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BKK	Bangkok port
BOT	Board of Investment of Thailand
EEDI	Energy Efficiency Design Index
EMS	Environmental Management System
ESI	Environmental Ship Index
GRF	Garbage Reception Facility
IMO	International Maritime Organization
LCM	Laem Chabang Municipality
LCP	Laem Chabang Port
MANOVA	Multivariate Analysis of Variance
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environment Protection Committee
PAT	Port Authority of Thailand
PCD	Pollution Control Department
RH	Research Hypothesis
RO	Research Objective
RQ	Research Question
UNCLOS	United Nations Convention on the Law of the Sea
WPCI	World Ports Climate Initiative

CHAPTER I

INTRODUCTION

1.1 Statement of the Problem

Since the early 1970s, ship-generated garbage has been prioritized in the world agenda as the substantial cause of marine pollution (Waldichuk, 1973). Its negative effects on marine environment, such as the quality of sea water and the living of marine creature, are well documented by worldwide scholars. Initially, different means for dealing with the negative externality generated from the ship-generated garbage were dissimilarly implemented from country to country (International Maritime Organization [IMO], 2015). This implementation was standardized by the International Convention for the Prevention of Pollution from Ships or MARPOL 73/78, which was adopted by the International Maritime Organization (IMO) in 1973, and then enforced in 1978 (IMO, n.d., 2011, 2015). The Annex V of MARPOL convention describing the regulation of garbage prevention from ship was accepted by 151 contracting states while there are 154, 146, 138 and 87 contracting states ratifying the Annex I/II, Annex III, Annex IV and Annex VI respectively (IMO, 2016). As a result, almost 99 percent of the world's merchant fleets were under the enforcement of MARPOL regulations (IMO, 2016). The current status of each Annex in MARPOL 73/78 is presented in Table 1.1.

Table 1.1 The status of MARPOL 73/78

Annex	Name	Enforcement date	No. of Contracting parties	% of world tonnage
Annex I	Prevention of pollution by oil	2 October 1983	154	98.73
Annex II	Control of pollution by noxious liquid substances	6 April 1987		
Annex III	Prevention of pollution by harmful substances in packaged form	1 July 1992	146	98.15
Annex IV	Prevention of pollution by sewage from ships	27 September 2003	138	90.96
Annex V	Prevention of pollution by garbage from ships	31 December 1988	151	98.32
Annex VI	Prevention of air pollution from ships	19 May 2005	87	95.69

Source: International Maritime Organization (2016: 14)

According to Table 1.1, the huge response of different nations to the regulations of MARPOL 73/78 seems to generate a great opportunity for building up the environmentally-friendly transportation around the world. Unfortunately, the consequence is not good as previously expected. There are many academic evidences pointing out the drawback of MARPOL convention and the misconduct of ship and port operators was found in many countries. The works of Horsman (1982), Jones (1995), Henderson (2001), Derraik (2002), Hinojosa and Thiel (2009), Ng and Song (2010), Chen and Liu (2013) and Jaccoud and Magrini (2014) illustrated that the garbage-related regulations of MARPOL 73/78 had scarce effect on the reduction of marine pollution as the illegal dump of garbage from cargo ships was still found after an enforcement of this convention. At the same time, the growing number of ship-

generated garbage accumulated in marine environment such as plastic garbage, metal can, glass, rag, battery and small container etc. was reported in many studies such as the research of Jones (1995), Rees and Pond (1995), Henderson (2001), Derraik (2002) and Chen and Liu (2013) and so on. This marine debris was proved by several scholars as one of the major causes of the entanglement of aquatic wildlife (Vauk and Schrey, 1987; Henderson, 2001; Gall and Thompson, 2015) and threat to marine ecosystem that can lead to the loss of marine biology (Laist, 1987; Phillips, 2015). Furthermore, the accumulation of marine debris can injure human during recreational activities (Jones, 1995). Jones (1995) also found that either the operation of ship can be obstructed from the accumulated garbage, such as lines, plastic bags and synthetic nets, during sailing. The aforementioned problem can lead to the loss of the national economy (Jones, 1995). Therefore, the measures and regulations for preventing marine pollution from ship-generated are heavily placed on the management and operation onboard and onshore. This causes seaports to be the focal points of IMO.

In this day and age, seaports become the vital mechanic in marine pollution prevention from ship-originated garbage. Owning to an increasing number of cargo passing through its facilities, seaports become the critical source of marine pollution from oil, noxious liquid substances, sewage from ships and garbage from ships (IMO, 2011). Economically, seaports are seen not only as the interface between sea and land transportation, but they are considered as the strategic point linking a large number of logistics activities of different stakeholders in the supply chain (Song and Panayides, 2008). Because of the intense port activities in the 21th century, especially in the leading container ports at which are the distribution centers of the world such as port of Singapore, Shanghai, Rotterdam and Hamburg, the marine pollution prevention measures and tools have become more important than ever before (Lam and Notteboom, 2014). With this reason, IMO has encouraged all ports of call, based on the 7th regulation of Annex V of MARPOL 73/78, to provide an adequate facility for receiving garbage from ships (IMO, 2011). Port state control and flag state are considered as the critical players on the achievement of adequate provision of garbage reception facility (GRF). Their power, as described in the 8th regulation of Annex V, should be sufficiently exercised so as to maintain the environmental standard of seaports (IMO, 2011). Apart from the regulations of MARPOL convention, the Marine Environment Protection Committee (MEPC), which is the active working agent of IMO, assists the practices of port authority in ensuring the adequacy of GRF by developing guidelines such as GUIDELINES FOR ENSURING THE ADEQUACY OF PORT WASTE RECEPTION FACILITIES in 2000 (IMO, 2000) and GUIDELINES FOR THE IMPLEMENTATION OF MARPOL ANNEX V in 2012 (IMO, 2012) and so on. Over many decades, the huge attention of the international regulators and scholars has been on the developing ways to ensure physical adequacy of GRF.

However, ensuring an adequacy of GRF is not a simple task as its success depends on many factors (Olson, 1994). For example, the management and operation onboard and onshore should be designed in the ways that satisfy the regulatory requirements and the economic benefit, which is difficult to balance. Moreover, it was found that the green shipping practices must be attained at the organizational level prior to its extension to the external integration with partners. The critical information should be sufficiently shared with the shipping firms, in order that seaports can prepare the

reception facilities more adequately and so on. These are the reasons why several ports were explored failing to accomplish this goal (Carpenter and Macgill, 2005). To address the problem, the solutions can be found in the work of Olson (1994), who pointed out how to provide GRF adequately in port based on the regulatory requirements (Olson, 1994). Other approaches for enhancing the GRF management in port area were also recommended by several scholars such as Bateman (1996), Ball (1999), Carpenter and Macgill (2005) and Senarak (2016) and so on. Instead of concentrating on the physical adequacy of GRF, Cho (2009) argued that the opinion of ship masters and crews in Korean fishery industry also affects the effectiveness of ports' GRF in preventing marine pollution from ship-generated garbage, due to the fact that ship operators are free to decide whether they will deliver their garbage at GRF or not. This implementation can be performed as long as their operation does not aggravate negative consequence to society (Cho, 2009). According to this finding, the GRF in seaports might not be used by ship operators despite being provided adequately. The negative opinion of ship master and crews working onboard also causes the environmental misconduct. It was reported that the illegal discharge of prohibited garbage into the sea stems from the misconception about marine environment of the crews (Jones, 1995; Ball, 1999; Derraik, 2002; Cho, 2009; Chen and Liu, 2013). To sustainably remedy this challenge, the researchers agreed that the education, as well as course training regarding marine pollution prevention and environment, should be continuously supplied for the crews. Besides, other preventive means were also recommended by many researchers such as providing the incentive scheme, which can draw the attention of polluters to return their garbage to GRF (Cho, 2009), setting up the reasonable charging price which provides an incentive cost to ship operators (Bateman, 1996; Georgakellos, 2007), enhancing the enforcement of national laws as well as port regulations with reward and penalty that can increase the environmental performance of seaports (Knapp and Franses, 2009; Lam and Notteboom, 2014), sharing critical imformation with seaports so as to increasing the accuracy of plan (Lai, Wong and Lam, 2014 and so on.

In spite of a number of studies suggesting how to improve environmental performance in shipping business, there are still many rooms for further developing. The previous studies concentrated on the effect of accumulated ship-generated garbage on the entanglement of marine creature (Vauk and Schrey, 1987; Henderson, 2001; Derraik, 2002; Butt, 2007; Hinojosa and Thiel, 2009; Ng and Song, 2010; Gall and Thompson, 2015; Phillips, 2015), the investigation and assurance of adequacy of GRF at port (Waldichuk, 1973; Olson, 1994; Bateman, 1996; Ball, 1999; Carpenter and Macgill, 2005), the factors affecting the discharge of ship-generated garbage into the sea (Cho, 2009; Chen and Liu, 2013), estimation of the amount of garbage generated onboard (Horsman, 1982, Ulnikovic, Vukic, and Nikolic, 2012), the estimation of the amount of ship-generated garbage delivered at GRF (Senarak, 2016) and the development of the policy that convinces ship operators to environmentally-friendly design their ship and management (Cho, 2009; Knapp and Franses, 2009; Chen and Liu 2013; Jaccoud and Magrini 2014; Lam and Notteboom, 2014). Firstly, there is no study exploring the ways to persuade liner shipping operators to deliver their ship-generated garbage to the GRF at the ports of call. Secondly, the success of marine pollution prevention does not depend on only the adequacy of the GRF at seaports, as it was proved by Cho (2009) that it also relies on the motivation of ship masters and crews. This highlights the role of ship operators', ship masters' and crews' motivation and

factors affecting this motivation. Thirdly, the delivery of ship-generated garbage at GRF heavily depends on the collaborations between seaports and shipping firms. Seaports with inefficiency of GRF operation can discourage ship operators to use GRF as they avoid the delay to ship operation (Cho, 2009). Contrarily, the shipping companies will seek those seaports with good environmental performance as their supply chain partners that can gain benefits through green performance, good public reputation and total cost reduction (Lai et al. 2011; Yang et al. 2013). This argument sheds light on the need for seaports to increase their operational and environmental performances through sharing the critical information and mutually developing service or process with partners and so on, because this collaborations can increase the seaports' environmental performance and competitiveness. Hence, the green shipping collaborations (GSC) is claimed by this study as the critical factor that not only enhances marine pollution prevention from ship-generated garbage, but also the competitiveness of supply chain partners. Port managers are required to understand what GSC is, why GSC is important to their business and how GSC provides benefits to seaports and their partners. Over the past decade, the concept of port supply chain, integration and GSC was well scrutinized by a number of scholars such as Song and Panayides (2008), Tongzon, Chang, and Lee (2009), Panayides and Lun (2009), Hoshino (2010), Wang and Cheng (2010), Lam and Yap (2011), Lai et al. (2011), Lam (2011), Lam and Voorde (2011), Plambeck (2012), Zhang and Lam (2014), Hall, Brien, and Woudsma (2013), Parola, Satta, and Caschili (2014), Lam, Ng, and Fu (2013), Yang et al. (2013), Chang (2013) and Ascencio et al. (2014) and so on. Nevertheless, no one is paying attention to the collaborations between seaports and shipping firms in the operation of garbage reception facility (GRF) in container ports. This indicates the gap in the existing literature that can be filled in by this study.

Comparing with other types of seaport, the container ports play an increasing role on the development of the world economy. Due to the expansion of the consumption market in many countries, the number of container cargo passing through container ports in different parts of the world continuously grows from year to year (IMO, 2016). Furthermore, most of the shippers prefer door-to-door service, which is heavily supported by containerization, to the fragmented services. This popularity considerably urges the figure of containers throughput at seaports. Similar to other leading container ports, Laem Chabang Port (LCP) witnesses the growing volume of container throughput and the increasing number of ships (Port Authority of Thailand [PAT], 2013). The emerging challenge coming along with this growth is the environmental-related misconduct of the container lines. Since 2007, it has been reported that almost a hundred ships unlawfully dumped garbage into the sea during sailing to berth at LCP which, at the end, aggravated marine debris in the coastal line nearby including Pataya, Bangsean, BangPha and Sriracha beach and so on (Nomsin, 2007). Even though the green policy has been initiated since 2011 by Port Authority of Thailand (PAT) in the main container port such as Bangkok port (BKK) and LCP (The Board of Investment of Thailand [BOT], 2015), the floating garbage produced by ships' operation still appears on the surface of sea water and accumulates in marine ecosystem in/around port area, which results in the degradation of marine environment (Pollution Control Department [PCD], 2013). To renovate the garbage management in ports of Thailand; thus, the Marine Department of Thailand conducted the project called "Waste Management in Thai Ports" in 2008 which aims at gathering the current

information about garbage management in different Thai ports, analyzing the garbage management system and determining the management policy (Marine Department, 2008). In this study, the information regarding the general management, laws and regulations, technical treatment and disposal of waste, etc., was well documented; however, the gap for further improvement is still found. It lacks the concept of collaborations between shipping firms and seaport, which is important for the practitioners' operation and management. The related studies were found but none of them filled this gap (Soontree et al., 2010; Phillips, 2015), except the work of Senarak (2016), who sheds light on the benefit of the econometric model on the management of ship-generated garbage in LCP.

According to the aforementioned discussion, this study aims to (1) contribute the work of the practitioners in the container port by analyzing the existing performance of the provision of GRF service in LCP from the perspective of the shipping companies based on the regulations of Annex V in MARPOL 73/78. The finding is expected to enable port authority to find the ways to improve the performance of the GRF service. Furthermore, this study also aims to (2) assist the current literature (2.1) by exploring the factors that affect the motivation of the shipping firms to deliver their ship-generated garbage at GRF at the study port, (2.2) by analyzing the relationship between paired levels of shipping collaborations based on the theory of Cohen and Roussel (2005), and (2.3) by discovering the benefits that are generated from the green shipping collaborations between Laem Chabang Port and shipping firms in ship-generated garbage management. The finding of this research objective is expected to generate a new body of knowledge that can fill in the current gap of the previous literature. Moreover, the policy implication from the finding is expected to be the guideline for policy makers and national legislators in improving the garbage management tools, which is the substantial foundation of sustainable marine pollution prevention.

1.2 Research Objectives

1.2.1 To survey the levels of existing performance of the provision of garbage reception facility (GRF) of Laem Chabang Port (LCP) from the shipping firms' perspective based on the regulations of Annex V in MARPOL 73/78.

1.2.2 To analyze the impacts of factors on the motivations of shipping companies in delivering their ship-generated garbage at the GRF of LCP.

1.2.3 To analyze the relationship of collaborations between LCP and the shipping companies and suggest ways to increase the collaborations in managing ship-generated garbage.

1.2.4 To analyze the benefits expected to gain from the collaborations between LCP and the shipping companies.

1.3 Research Questions

1.3.1 What is the current performance of the provision of garbage reception facility (GRF), under the regulations of Annex V in MARPOL 73/78, provided by Laem Chabang Port (LCP)? *(Research Question 1-A).*

1.3.2 Is the existing performance perceived differently among the groups of the shipping firms? *(Research Question 1-B).*

1.3.3 What are the factors that affect the motivation of the shipping firms to deliver their garbage at the GRF of LCP? *(Research Question 2-A).*

1.3.4 Are the motivations different among the groups of the shipping firms? *(Research Question 2-B).*

1.3.5 What is the relationship between levels of collaborations? *(Research Question 3-A).*

1.3.6 What are the benefits of collaborations between LCP and the shipping firms in ship-generated garbage management? *(Research Question 4-A).*

1.3.7 Are the benefits of collaborations between LCP and the shipping firms different among the groups of the shipping firms? *(Research Question 4-B).*

1.4 Research Hypothesis

1.4.1 The Research Question 1-A can be answered by using the scores evaluated by the shipping firms via the questionnaire survey. Hence, this research question has no research hypothesis.

1.4.2 The answer of the Research Question 1-B can be found from the statistics test of the following hypothesis:

Research Hypothesis 1-B

H_0: the existing performance of GRF is perceived similarly among the groups of the shipping firms.

H_1: the existing performance of GRF is perceived dissimilarly among the groups of the shipping firms.

1.4.3 The answer of the Research Question 2-A can be explored from the score evaluated by the shipping firms via the questionnaire survey. Thus, this research question has no research hypothesis.

1.4.4. The answer of the Research Question 2-B can be discovered from the statistics test of the following hypothesis:

Research Hypothesis 2-B

H_0: the motivations to deliver ship-generated garbage at the GRF are not different among the groups of shipping firms.

H_1: the motivations to deliver ship-generated garbage at the GRF are different among the groups of shipping firms.

1.4.5 The answer of the Research Question 3-A can be obtained from the statistics test of following hypothesis:

Research Hypothesis 3-A

H_o: there is the positive relationship between paired levels of collaborations.

H_1: there is the non-positive relationship between paired levels of collaborations.

1.4.6 The answer of the Research Question 4-A can be found from the score evaluated by the shipping firms. As a result, this research question has no research hypothesis.

1.4.7 The Research Question 4-B can be answered by the result of the statistics test of the following hypothesis:

Research Hypothesis 4-B

H_0: the benefits of collaborations with port are not different among the groups of shipping firms.

H_1: the benefits of collaborations with port are different among the groups of shipping firms.

The alignment of research objectives, research questions and research hypothesis is depicted in Figure 1.1.

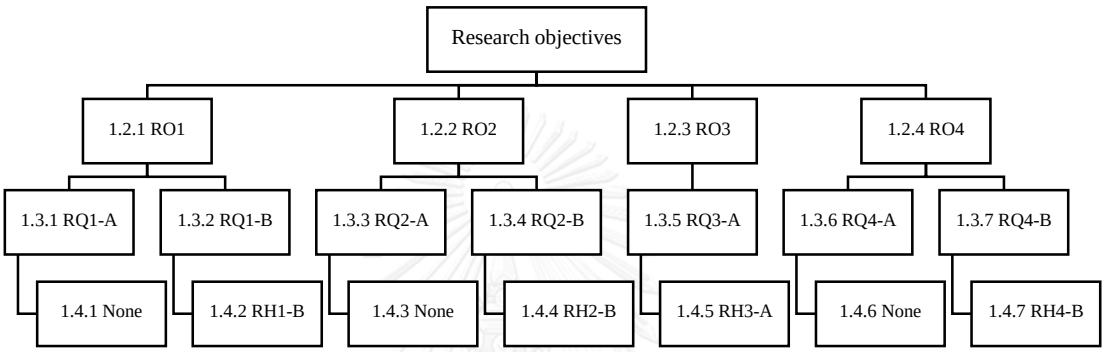

Figure 1.1 Alignment of research objectives, questions and hypothesis.

Remark RO is abbreviated for research objective, RQ is abbreviated for research question and RH is abbreviated for research hypothesis.

1.5 Scope of Study

1.5.1 This study concentrates on the management of waste, which is listed in the Annex V of MARPOL convention while the other types of ship-generated waste not listed in the Annex V are excluded from the analysis. Corresponding with Annex V, there are 3 main types of garbage – victual waste, domestic waste and operational waste respectively – which are included in the analysis of this study. The garbage listed in the Annex V of MARPOL 73/78 is presented in Figure 1.2.

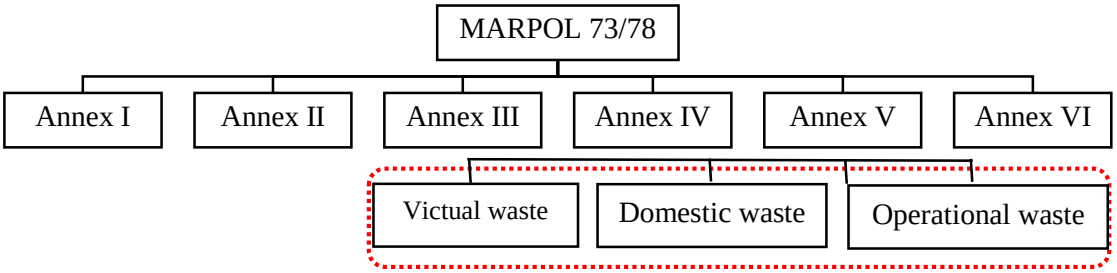

Figure 1.2 Garbage as listed in Annex V
Source: International Maritime Organization (2016: 99-168)

1.5.2 The collaborations in Research Objective 3 concentrates between Port Authority of Thailand, the provider of garbage reception facility (GRF) in Laem Chabang Port (LCP), and the shipping companies delivering their ship-generated garbage at GRF of LCP.

1.5.3 The shipping companies in this study mean the ship operators or agents of 1) container vessels, 2) RO-RO vessels, 3) general cargo ships and 4) bulk carriers because they are the seagoing vessels, which are under the enforcement of MARPOL convention. Besides, they deliver their ship-generated operational waste at the GRF of LCP, while the other types of operator are excluded from analysis because their garbage is disposed by other means.

1.6 Location of Study

Laem Chabang Port (LCP) is one of the largest container seaports located on the east coast of the Gulf of Thailand, as shown in Figure 1.3. The port covers an area of around 2,536 acres (6,340 rais) under the administration of Port Authority of Thailand (PAT), which is the public utility state enterprise under the general supervision of the Ministry of Transport (BOT, 2015). It was established in 1991, in order to economically support the development of the Eastern seaboard of Thailand – the enormous center of Thailand for the export-oriented industries. The administration with private terminal operators in LCP is on Build-Operate-Transfer (BOT) basis (BOT, 2015).

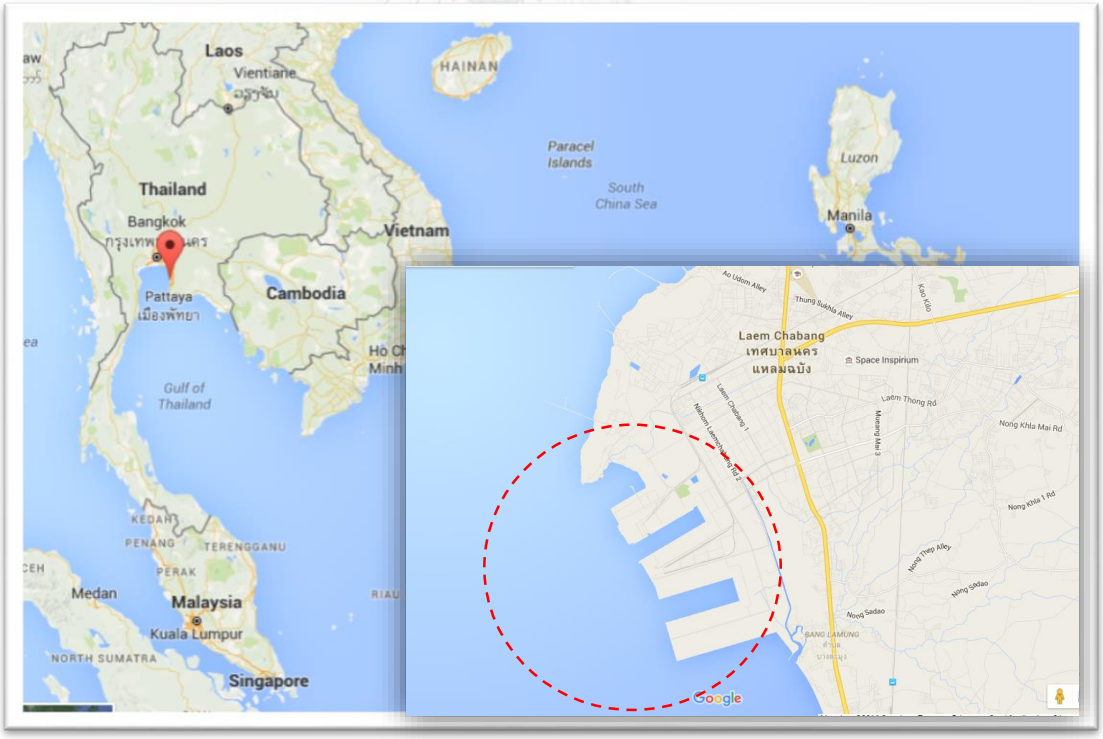

Figure 1.3 Location of Laem Chabang Port, Thailand

At the present time, there are active 12 terminals operated in LCP, as presented in Figure 1.3. It consists of seven container terminals, one multipurpose terminal, one Ro/Ro terminal, one passengers and Ro/Ro terminal, one general cargo terminal and one shipyard terminal (Laem Chabang Port [LCP], 2013). It is the host of the leading

terminal operators such as Hutchison, NYK and Evergreen, etc. Economically, LCP plays the vital role on the economic development of the country and the Southeast Asia (PAT, 2013). It has been considered as the regional gateway linking hundreds of domestic and international ports and facilitating almost 10,000 vessels per annum (Civil Engineering Division, 2015). Annually, LCP contacts with almost a thousand of ship operators and many companies are the leading container lines and agents such as CMA CGM, CNC, EVERGREEN, K LINE, Maersk Line, KMTC, SITC, MITSUI O.S.K. LINES, WAN HAI LINES, NYK LINE, APL, YANGMING and HAPAG-LLOYD etc. (Civil Engineering Division, 2015). The number of ships calling LCP per annum is shown in Figure 1.4.

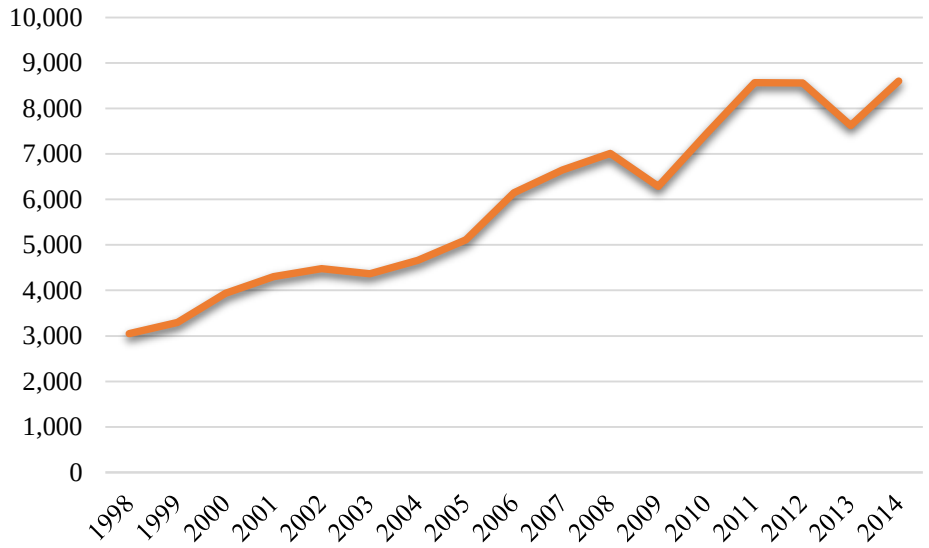

Figure 1.4 Number of ships calling Laem Chabang Port
Source: Ministry of Transport. Available from http://vigportal.mot.go.th/portal/site/PortalMOT/stat/index26URL/

In accordance with Figure 1.4, the number of ships calling LCP continuously increases over the past many years. This increasing figure of ships implies the growing amount of garbage delivered at LCP, as it was proved by Senarak (2016) that the amount of ship-generated garbage has a positive relationship with the number of ship calling LCP. This argument corresponds to the statistics of ship-generated operational waste and ship-generated general waste (victual and domestic waste) recorded by Port Authority of Thailand, as presented in Figure 1.5 and Figure 1.6 respectively.

Practically, the garbage that is delivered at LCP can be broadly classified, based on the regulation of MARPOL convention, into 3 main groups; namely, victual waste, domestic waste and operational waste. The regulations enforced on the operation of the first two groups are more relaxing than those of the last group, because it normally contaminates with the other type of waste, such as oil, etc., which can be recycled or mixed with hazardous waste legally restricted by laws.

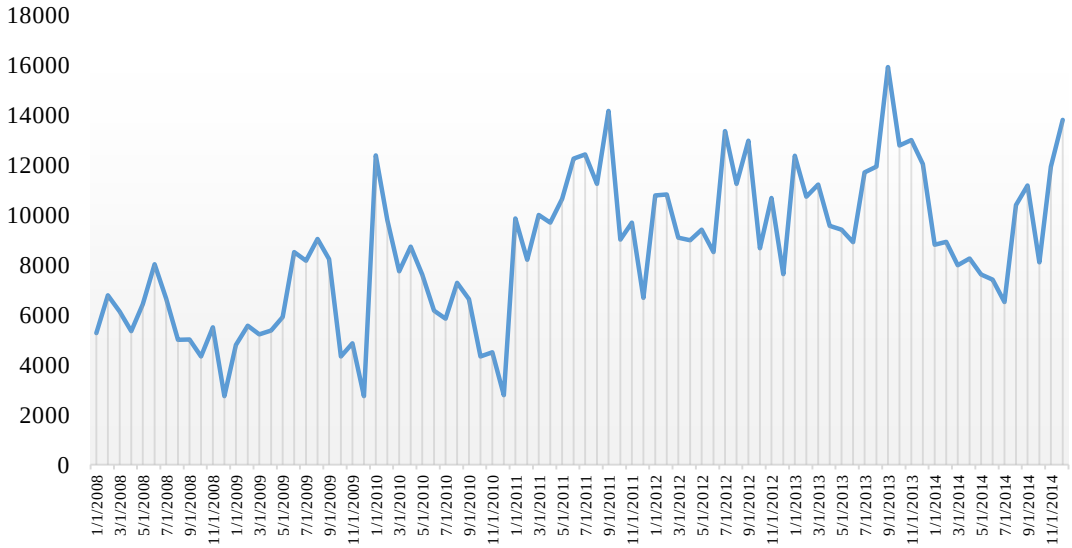

Figure 1.5 The amount of operational waste delivered at Laem Chabang Port, as from 2008 to 2014 (Unit: kilogram per month)

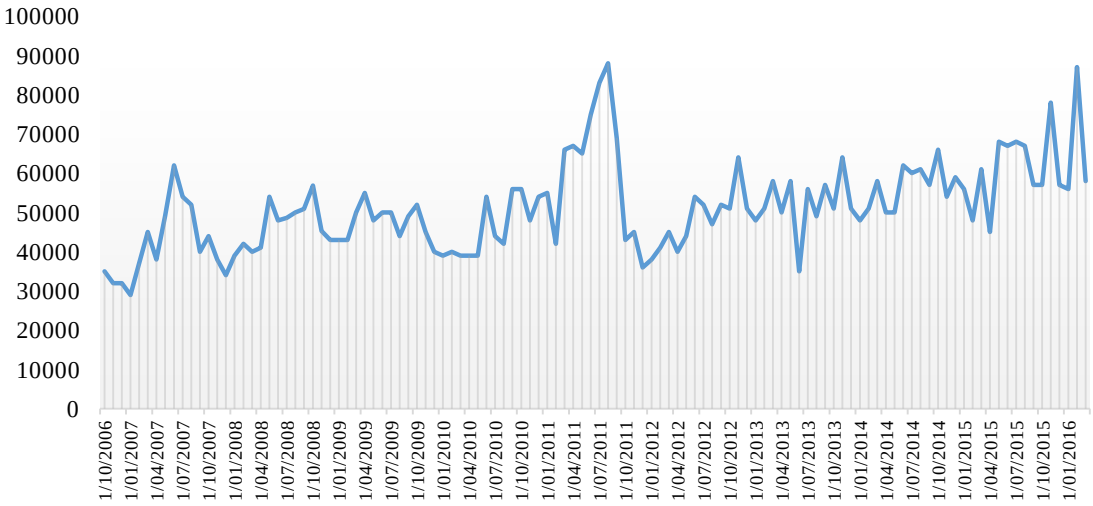

Figure 1.6 The amount of domestic and victual waste delivered at Laem Chabang Port, as from 2006 to 2016 (Unit: kilogram per month)

Corresponding with Figure 1.5, the amount of ship-generated operational waste has an upward trend with high fluctuation since 2008. Likewise, the amount of victual waste combined with domestic waste, as shown in Figure 1.6, indicates an insignificantly upward trend with a slightly oscillation from 2006 to 2016.

The garbage reception facility (GRF) was built up in LCP, in order to particularly manage the operational waste, while the victual waste and the domestic waste are transferred by trucks of Laem Chabang Municipality to its land fill for disposal. The GRF of LCP generally comprises of 1) medium-size shed with four spaces for storing different types of operational waste and one large space for sorting operation, 2) three garbage-collecting trucks, 3) two labors working on the collecting

truck and 4) one labor working at the sorting shed (Civil Engineering Division, 2015). Hence, the management of each type of ship-generated garbage is depicted in Figure 1.7.

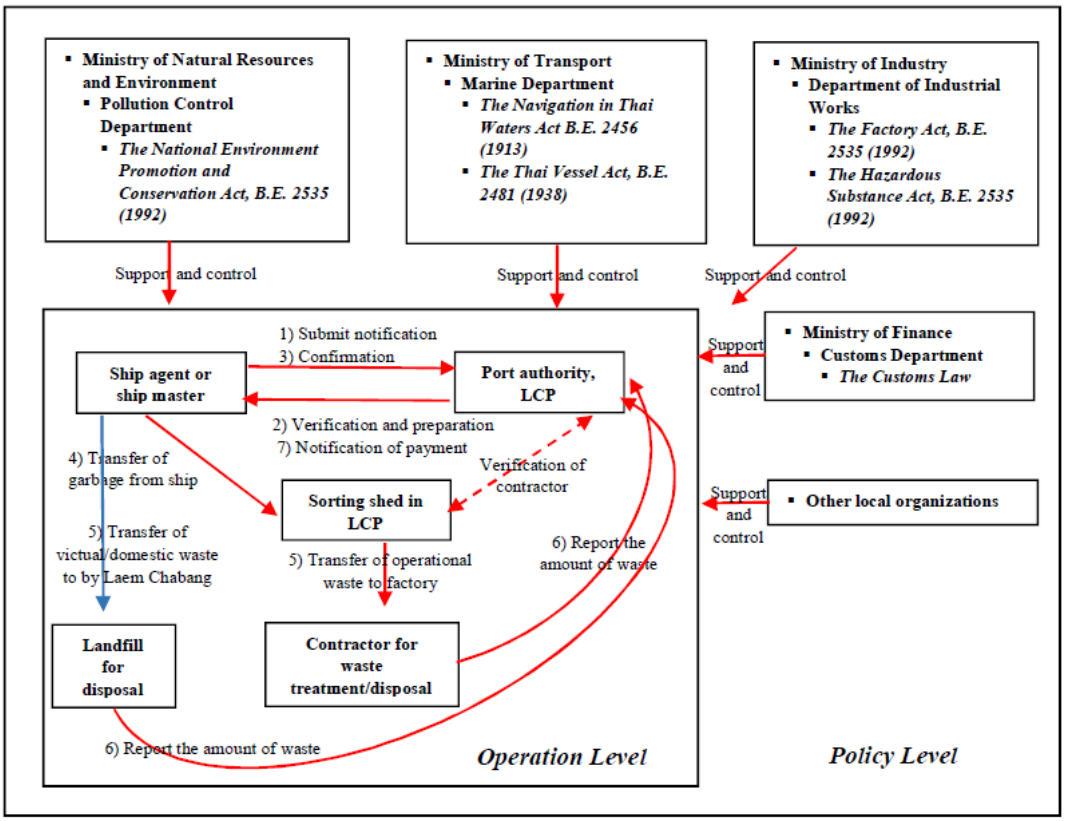

Figure 1.7 The current operations of ship-generated garbage in LCP

According to Figure 1.7, considering at the operation level, the ship agents or ship masters, who would like to use the GRF service of LCP, have to submit their notification form to the authority at least 24 hours prior to the ships' arrival. Generally, the victual waste and domestic waste are directly transferred to the landfill of Laem Chabang Municipality for disposal as it is not dangerous to marine environment while the operational waste will be kept at the garbage reception facility of LCP, in order to sort it into a particular group of waste. After that it will be transferred by the private contractor, as licensed and registered at Marine Department of Thailand, to the factory for treatment or disposal (Civil Engineering Division, 2015).

Currently, Civil Engineering Division of LCP is directly responsible for all garbage-related operations including GRF maintenance, process planning and statistic record, etc., whereas Port Authority of Thailand (PAT) is in charge of developing the environmental regulation and policy, as well as the cooperation with the other institutes for technical assistance. Considering at the policy level, there are four main governmental organizations related to the management of ship-generated garbage including 1) Pollution Control Department under the administration of Ministry of Natural Resources and Environment, 2) Marine Department under the administration of Ministry of Transport, 3) Department of Industrial Works under the administration of Ministry of Industry and 4) Customs Department under the administration of

Ministry of Finance (Marine Department, 2008). Their responsibility is to control the management of ship-generated garbage in the environment-friendly ways by enforcing domestic laws. The detail of each regulations is explained in Chapter 2.

1.7 Theoretical Focus and Gap in the Previous Literature

As mentioned in 1.1 that this study aims to fill in the gap in the previous literature; therefore, a series of studies were reviewed in order to identify the gap, while the related theories were gathered so as to support the analysis of the study. After reviewing the previous literature since the early 1970s, the studies related to marine pollution prevention from ship-generated garbage can be broadly classified in 3 main groups; 1) ship-generated garbage management based on Annex V of MARPOL 73/78, 2) supply chain in port and 3) green shipping integration as shown in Figure 1.8.

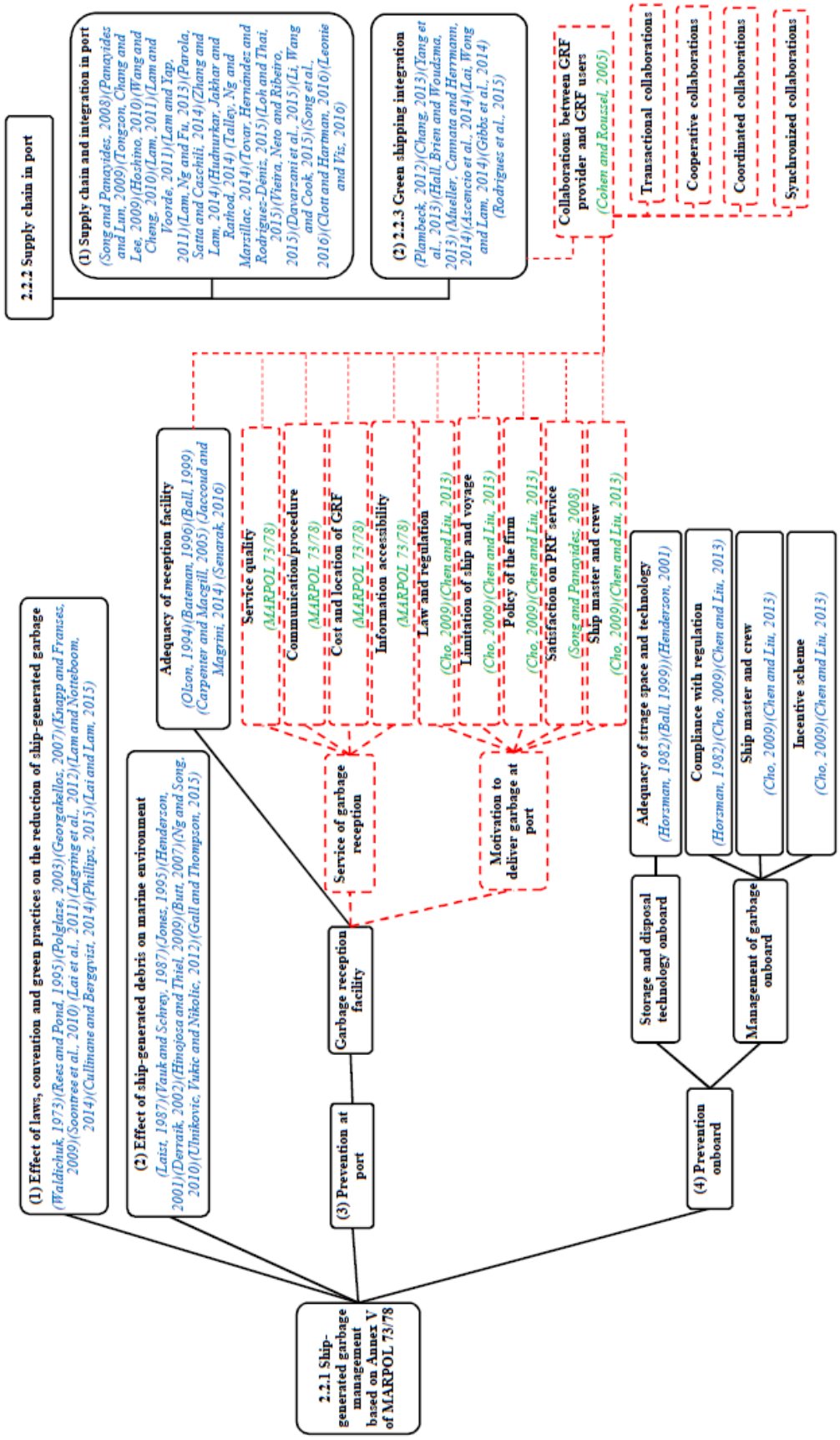

Figure 1. 8 Theoretical focus and gap in the previous literature

Corresponding with the Figure 1.8, the topics that were already studied are indicated by the solid line, while the topics that are the focal points of this study are shown in the dash line. It is noticed that a huge attempt was paid on the study in ship-generated garbage management based on Annex V of MARPOL 73/78 (as discussed in 2.2.1), especially in the effect of laws, convention and green practices on the reduction of ship-generated garbage and the effect of ship-generated debris on marine environment, while a few studies focused on the prevention of ship-generated garbage onboard. At the same time, many studies concentrated on how to measure the physical adequacy of reception facility in port, which is not enough for seaports to prevent marine pollution from ship-generated garbage, because the garbage reception facility (GRF) cannot be used to effectively prevent marine environment without the good provision of its service, such as the quality of GRF service, the efficiency of communication system between the provider and user, the ease of procedure to use GRF service, the reasonable charging system, the location of GRF and the accessibility to the GRF service information. This study argues that the adequacy of GRF as well as its service, as the supply side of GRF provision, are critical for seaports that need to convince the shipping companies to deliver their garbage. Apart from the supply side, the motivation to deliver garbage from ships operated by the shipping companies is also important for the success of the marine prevention, as the delivery of ship-generated garbage at the GRF depends on the decision making of the shipping firms. With this reason, the management of ship-generated garbage needs to be considered by both sides from seaports' and shipping firms' perspectives. This concept has never been studied by any scholars. To link the demand and supply sides, this study claims that seaports and shipping firms need to collaborate with one other. Hence, the review of literature regarding port supply chain and green collaborations was conducted and discussed in 2.2.2 and 2.2.3 in Chapter 2. The concept of green shipping collaborations was drawn from the previous literature to adopt in ship-generated garbage management. The aim of this theoretical synchronization, as depicted by the red dash line, is to enhance the management of ship-generated garbage through shipping collaborations between seaports and shipping firms. This combination is supposed to lead to the exploration of a new body of knowledge in green shipping collaborations that can effectively enhance the ship-generated garbage management.

1.8 Methodology

1.8.1 The underlying parameters and measure development

1.8.1.1 Objective 1

In order to investigate the existing performance of the garbage reception facility (GRF) of Laem Chabang Port (LCP), the related parameters were mainly extracted from the regulations of Annex V in MARPOL 78/78, the work of Song and Panayides (2008) and the interview of the officers working in Civil Engineering Division - the division that provides GRF in LCP. All parameters were organized into 6 groups that measure different dimensions of performance of the GRF service including 1) the adequacy of the GRF, 2) the quality of the GRF service, 3) the ease of communication and procedure to use GRF service, 4) the cost of GRF service, 5) the location of GRF service provision center, and 6) the accessibility to the GRF service

information. Each group has a different number of statements relying on the details of each topic. The questionnaire survey and the evaluation scale of each statement is based on the direction in the work of Lai et al. (2014) who used the Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree).

1.8.1.2 Objective 2

A set of parameters of factors affecting the motivation of the shipping firms was mainly extracted from the work of Song and Panayides (2008), Cho (2009), Chen and Liu (2013) and the regulations in the Annex V of MARPOL 73/78. The content validity was initially ensured by intensive literature review, in order for the questionnaire to cover all the related contents. The list of statements used to elicit the reasons why the shipping companies use the GRF of Laem Chabang Port (LCP) was arranged under 5 topics: 1) law and regulation; 2) navigation limitation; 3) cooperation; 4) competitiveness; and 5) environmental consciousness. The number of the statements varies depending on the details of each topic. The questionnaire survey and the evaluation scale for each statement is based on the direction in the work of Lai et al. (2014) who used the Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree).

1.8.1.3 Objective 3 and objective 4

The literature regarding the collaborations and the green supply chain in port was intensively reviewed so as to investigate the benefits of the collaborations on the performance of the firm and environment. After that they were inferred as the benefit of the collaborations in the management of garbage reception facility in port. Furthermore, the theory of collaborations proposed by Cohen and Roussel (2005) is used as the baseline for analyzing the relationship of paired levels of collaborations in ship-generated garbage management between Laem Chabang Port and the shipping lines. A set of parameters reflecting the characteristics of collaborations was extracted from the study of Plambeck (2012), Chang (2013), Yang et al. (2013), Hall et al. (2013), Mueller, Cannata, and Herrmann (2014), Ascencio et al. (2014), Lai, Wong, and Lam (2014), Gibbs et al. (2014) and Rodrigues et al. (2015). The parameters were organized into 4 topics reflecting 4 levels of collaborations, based on the theory of Cohen and Roussel (2005); namely, 1) transactional collaborations, 2) cooperative collaborations, 3) coordinated collaborations, and 4) synchronized collaborations. The number of the statements varies depending on the details of such the topic. The evaluation scale for each statement is based on the direction in the work of Lai et al. (2014) who used the Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree).

1.8.2 Population and sample

The population of the study in the questionnaire survey is the shipping companies and agents who utilize the garbage reception facility (GRF) of Laem Chabang Port (LCP). According to the database of the Port Authority of Thailand (PAT), there are around 300 ship operators berthing and using the facilities of LCP (Civil Engineering Division, 2015). However, once the non-GRF user such as barge operators, offshore supply vessel operators, etc., and the redundant names of the

operators are excluded from the list, 148 operators including operators of container ship, general cargo vessel, Ro-Ro vessel and bulk carrier remain (Civil Engineering Division, 2015). In order to obtain the information as completely as possible, the study uses the purposive sampling technique to specifically pick up one respondent per company. All respondents are required to be in charge of garbage-related operation on shore or onboard. Moreover, they must have an experience in contacting the authority of LCP.

1.8.3 Data collection

The required data for developing the questionnaire is gathered from literature reviews and the interviews of staff from Marine Department of Thailand and Port Authority of Thailand, while the needed data for analysis is collected from questionnaire survey, as presented in Figure 1.9. For the latter case, it aims to gather the data from the shipping firms based on the research objectives 1 - 4 as presented in 1.2.1-1.2.4. The questionnaire is developed and submitted to the shipping firms via two channels – email and online channels. The names of the shipping companies and agents were obtained from the database of Port Authority of Thailand. The contact addresses and telephone numbers are mainly accessible through the Google search engine, but some of the information is given by colleagues. Afterwards, telephone calls are used to contact the companies and to search for suitable representatives. The respondents are specifically selected based on their responsibility and experience regarding ship-generated garbage operation and management, and then are asked to indicate the degree to which they agree or disagree to the statements by using the Likert-scales ranging from 1 (strongly disagree) to 5 (strongly agree).

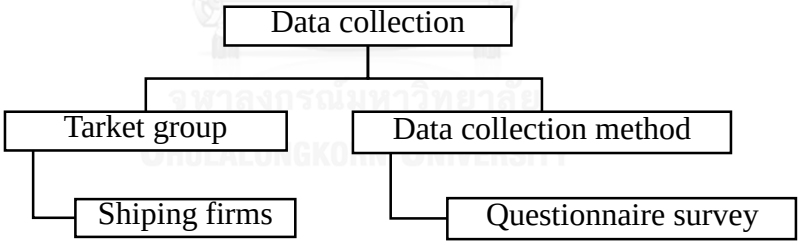

Figure 1.9 Summary of data collection and target groups

1.8.4 Method

1.8.4.1 The method for Research Objective 1

As the Research Hypothesis 1-A has no research hypothesis, the descriptive statistics is used to analyze the score evaluated by the shipping firms on different dimensions of the performance of the GRF service provided in Laem Chabang Port, as discussed in 1.8.1.1.. The level of performance is analyzed based on the given score, which reflects the overall performance perceived by the shipping firms. Contrarily, for the Research Hypothesis 1-B which is based on the Research Question 1-B, the multivariate analysis of variance (MANOVA) is used to test whether the opinion on the performance of GRF service is perceived differently among the groups

of the shipping companies or not. The groups of shipping firms are divided into 3 groups based on 1) transactional collaboration (high, moderate and low frequency of ships berthing at LCP per year), 2) nationality of shipping firms and 3) types of ships. The detail of each variable included in MANOVA is explained in Chapter 3.

1.8.4.2 The method for Research Objective 2

Corresponding with the Research Question 2-A, the descriptive statistics including average, minimum and maximum, etc., is adopted for analyzing the score evaluated by the shipping dims from the questionnaire survey, because it has no research hypothesis. This will illustrate the overall motivation for using the GRF, which can answer the Research Question 2-A. Thereinafter, the multivariate analysis of variance (MANOVA) is adopted to investigate the Research Hypothesis 2-B which aims to find that whether there are any differences of the motivation among the groups of the shipping firms. The finding obtained from this hypothesis testing can be used to answer the Research Question 2-B. The groups of shipping firms included in MANOVA in research objective 2 are divided into 3 groups - 1) transactional collaboration, 2) shipping-firm nationality and 3) type of ship. The detail of MANOVA is explained in Chapter 3.

1.8.4.3 The method for Research Objective 3

The Research Question 3-A aims to investigate the relationship of collaborations between Laem Chabang Port and the shipping firms in ship-generated garbage management. It is hypothesized that the levels of collaborations positively relate to one other. This null hypothesis is based on the concept in the work of Yang et al., (2013), who argued that the collaborations will allow the firms to enjoy the better environmental performance and competitiveness. The ordinal regression is adopted to test this postulate. After that, the answer of the Research Question 3-B will be obtained from testing the Research Hypothesis 3-B, which aims to explore that whether the relationship of different levels of collaborations differs among the groups of the shipping firms. The comparison method is adopted to test this hypothesis. Likewise, other research objectives and the groups of the shipping firms included in the analysis of research objective 3 are divided into 3 groups - 1) transactional collaboration, 2) nationality of shipping firms and 3) types of ships. The detail of multinomial logistic regression is explained in Chapter 3.

1.8.4.4 The method for Research Objective 4

The Research Question 4-A has no hypothesis as it requires to know the benefits of collaborations between Laem Chabang Port and the shipping firms in ship-generated garbage management. The answer can be explored from the overall score, which is analyzed by using descriptive statistics. In contrast, the Research Question 4-B aims to investigate that whether the benefits of the collaborations differ among the groups of the shipping firms. This can be accomplished by testing the Research Hypothesis 4-B by using multivariate analysis of variance (MANOVA). In MANOVA of this research objective, the groups of the shipping firms are divided into 3 groups

based on 1) transactional collaboration, 2) nationality of shipping firms and 3) types of ships. The detail of MANOVA is explained in Chapter 3.

At this stage, all research structures are explained completely. In order to illustrate the alignment of the research structures, the details of research objectives, questions, hypothesis and methodology are summarized and presented in Figure 1.10.

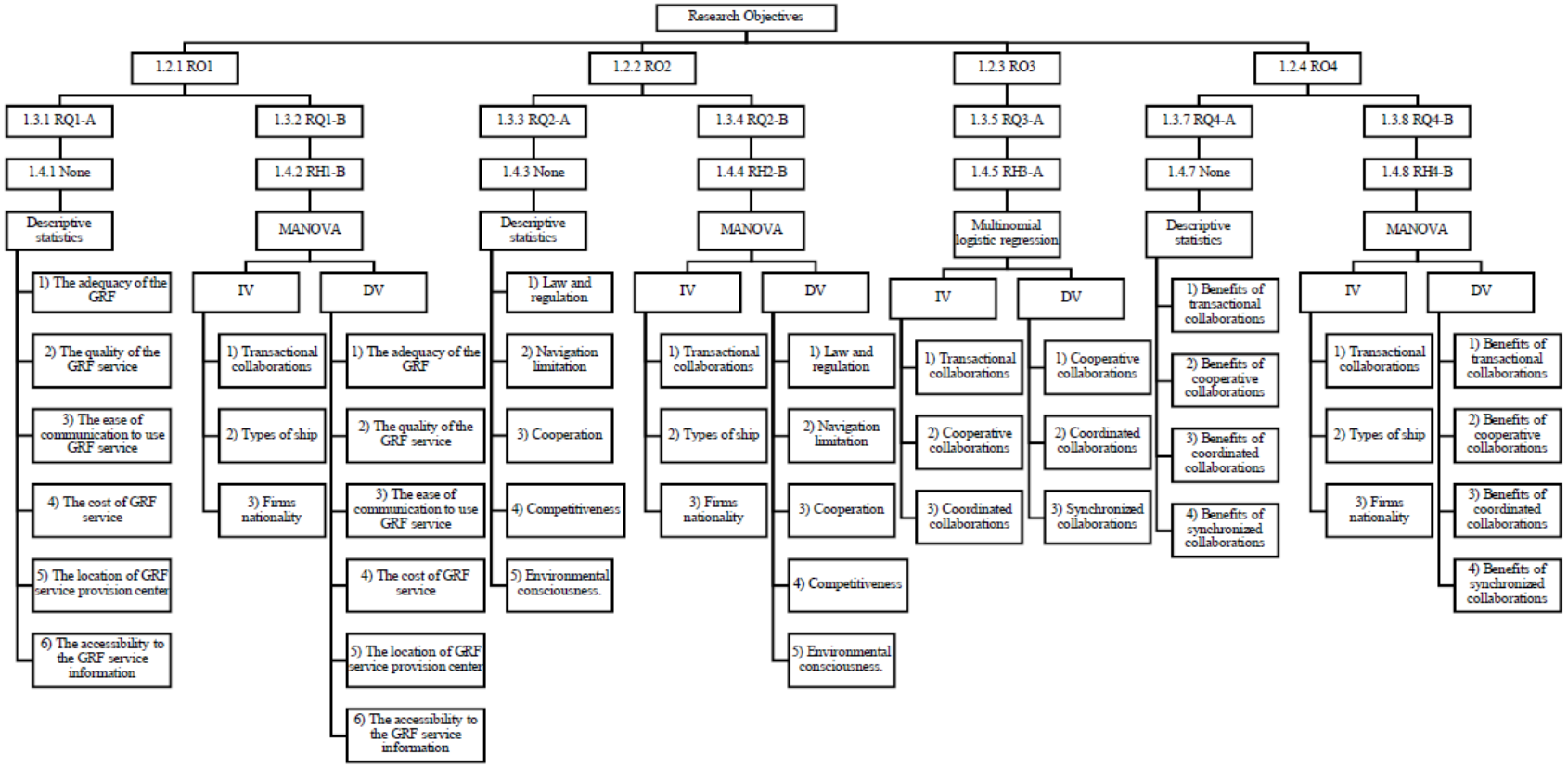

Figure 1.10 Alignment of research structures

1.9 Research Contribution

1.9.1 Research objective 1

The new parameters developed from this study to evaluate the performance of the garbage reception facility (GRF) is the new body of knowledge, which contributes to the current literature. Moreover, the finding of the research objective 1 is expected to enable Port Authority of Thailand (PAT) and the staff of Laem Chabang Port (LCP) to understand the current performance of the GRF service of LCP, so that they can improve its service in response to the perception of the shipping firms.

1.9.2 Research objective 2

The new parameters were developed from this study to assess the motivations of the shipping firms on the ship-generated garbage delivery at the GRF of LCP. In addition, the research finding explored in research objective 2 will point out the significant motivations of the shipping companies in deciding to deliver their ship-generated garbage at the GRF. This new body of knowledge can add value to the existing literature in maritime transportation field. Practically, this knowledge can also be adopted to improve the garbage management policy of LCP and other container ports, which will lead to the enhancement of marine pollution prevention.

1.9.3 Research objective 3 and 4

To attain the research objective 3 and 4 of this study, the new parameters for evaluating the levels and the benefits of collaborations between LCP and the shipping firms were developed. This development can fill in the gap in the existing literature. Furthermore, the relationship among shipping collaborations found in research objective 3 can be utilized to improve or develop the green shipping collaborations (GSC) between seaports and shipping firms. This can enhance the environmental performance and the competitiveness of both parties. Moreover, the research finding of research objective 4 will shed light on the benefits of the GSC in ship-generated garbage management which can be used to improve or redesign the GRF operation and management.

CHAPTER II
LITERATURE REVIEW

In Chapter 2, the related literature was reviewed in order to 1) identify the gap which can be added value by this study, 2) extract the parameters which can be adopted by this study, and 3) ensure the content validation of the study. In addition, the associated theories were also gathered to support the analytical process and conceptualize the relationship between the focal variables. Finally, the existing operation and management of ship-generated garbage and reception facility of Laem Chabang Port, related regulations and associated organizations were reviewed so as to explore the ways to enhance the seaports' abilities to prevent marine pollution based on the finding of this study. Therefore, the contents in Chapter 2 are organized into 3 main topics; namely, 1) theoretical frameworks, 2) review of the literature and 3) management of ship-generated garbage in Thailand, as presented in Table 2.1.

Table 2.1 Structure of Chapter 2

CHAPTER II		
2.1 Theoretical Frameworks 2.1.1 MARPOL 73/78 2.1.2 Annex V of MARPOL 73/78 2.1.3 Ensuring the adequacy of port waste reception facilities 2.1.4 Good practice for port reception facility providers and users 2.1.5 Port supply chain and green shipping collaborations	**2.2 Review of the Literature** 2.2.1 Study in ship-originated garbage management 2.2.2 Study in port supply chain and integration 2.2.3 Study in green shipping integration	**2.3 Management of Ship-Generated Garbage in Thailand** 2.3.1 Governmental group 2.3.2 Private group

Corresponding with Table 2.1, the vital theories that are used to conceptualize and support the analysis of this study are explained in 2.1. After that, a series of literature was intensively reviewed in 2.2 so as to explore the academic gap that can be filled in by this study. The literature was classified into 3 main groups, in order to simplify the process in identifying the scarcity of knowledge in the previous studies. Finally, the existing management and operation of ship-generated garbage in Thailand were described in 2.3. The related organizations, their management tools and flow of ship-generated garbage in seaport, etc., are also included in this section. The details of each topic are explained as follow:

2.1 Theoretical Frameworks

2.1.1 MARPOL 73/78

The International Convention for the Prevention of Pollution from Ships is the full name of MARPOL 73/78, which was adopted on the 2nd November 1973 at the International Maritime Organization (IMO) but did not enter into force (IMO, n.d., 2015, 2016). Five years later, 1978 MARPOL Protocol, which was further developed based on the regulation of 1973 MARPOL convention, was adopted at a Conference on Tanker Safety and Pollution Prevention. It was not effective until 1983 that the Annex I and II were enforced as it was heavily driven by the large-scale pollution from the casualty of the tanker Torrey Canyon in 1967. The economic and environmental losses from oil are the critical reason why all member states are compulsorily forced to accept the regulations of Annex I and II of MARPOL 73/78, while other Annexes were voluntarily accepted. Thereinafter, as the dramatic growth of seaborne trade, IMO further developed the regulations for controlling the pollution from harmful substances in packaged forms, sewage from ships, garbage from ships and air pollution from ships in the later years (IMO, 2016). These regulations were now included in the Annex III, Annex IV, Annex V and Annex VI of MARPOL 73/78 respectively. The enforcement date of each Annex is presented in Table 2.2.

Table 2.2 Summary of status of MARPOL 73/78

Annex	Name	Enforcement date	No. of Contracting parties	% of world tonnage
Annex I	Prevention of pollution by oil	2 October 1983	154	98.73
Annex II	Control of pollution by noxious liquid substances	6 April 1987		
Annex III	Prevention of pollution by harmful substances in packaged form	1 July 1992	146	98.15
Annex IV	Prevention of pollution by sewage from ships	27 September 2003	138	90.96
Annex V	Prevention of pollution by garbage from ships	31 December 1988	151	98.32
Annex VI	Prevention of Air Pollution from Ships	19 May 2005	87	95.69

Source: International Maritime Organization (2016: 14)

Corresponding with Table 2.2, there are 154 contrasting parties in Annex I/II covering 98.73% of the world tonnage (IMO, 2016). The Annex I of MARPOL 73/78 aims to regulate the operation regarding oil discharge from tankers. Generally, this annex contains 4 chapters with 26 regulations (IMO, 2011). The 1st chapter mentions about the general terms such as definition, application, surveys and inspections, an issue or endorsement of certificate, form of certificate, duration and validation of certificate, port state control and the operational requirement. The 2nd chapter of Annex I discusses the requirement for the control of operational pollution in detail, such as the control of oil discharge, and the method for prevention of oil pollution from ships while operating in special areas, reception facilities, etc., whereas the 3rd chapter describes the requirements for minimizing oil pollution from oil tankers owing to the side and bottom damage. The last chapter explains the reactive approach for preventing of pollution from an oil pollution incident (IMO, 2011).

The Annex II of MARPOL 73/78 is comprised of the regulations for the control of pollution by noxious liquid substances in bulk. The structure of this annex has 16 regulations and 12 chapters (IMO, 2011). The regulations begin with describing the general terms of wording and by what means to apply the regulations in this annex. The name list of 250 noxious liquid substances is classified in to a particular group based on its danger to marine environment and listed in the Appendix. The operational requirements regarding how to discharge noxious liquid substances, the pumping system, piping system as well as the unloading arrangement are intensively explained. Furthermore, the reception facilities and the unloading at the terminal are provided to guide the terminal operators and port state control. The discharge of their residues is prohibited only to the reception facilities until after the certain concentrations and conditions, which vary from the category of substances. To ensure the standard of ships used in transporting noxious liquid substances, the certification system is recommended to adopt, in order to minimize the possibility of the accidental pollution to occur. Nevertheless, in any case, no discharge of residues containing noxious substances is permitted within 12 miles from the nearest land (IMO, 2011).

The Annex III is comprised of 8 regulations with one Appendix describing the regulations for the prevention of pollution by harmful substances carried by sea in packaged form. Corresponding with the name of this annex that obviously indicates the significant of packages used for containing harmful substances. Therefore, it provides the requirements of the standards regarding packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications for preventing pollution from harmful substances (IMO, 2011). At the present time, there are 146 contracting parties, ratifying the regulations of Annex III, accounting for 98.15 % of the world tonnage (IMO, 2016).

The Annex IV of MARPOL 73/78 concerns with the regulations for the prevention of pollution by sewage from ships. It comprises of 11 regulations regarding the definition and the general terms that are necessary for interpreting the regulations in this annex (IMO, 2011). Despite having much lower danger to marine environment, the pollution prevention from sewage requires the survey of ships so as to maintain its standard. The certification system, including an issue of certificate by private or governmental agencies, form of certificate, etc., is also explained in the regulations. Moreover, the operational requirements, such as the discharge of sewage, the reception facilities and the standard discharge connections, etc., are also included in the convention so as to guide the implementation of the terminal operators and other related regulators. Over the past 13 years since it has entered into force, there has been 138 contracting parties in Annex IV of MARPOL 73/78, covering 90.96 % of the global tonnage (IMO, 2016).

The Annex VI is the newest annex of MARPOL 73/78 that entered into force in 2005 in response to the rising awareness of society on the air pollution generated from seaborne trade. Generally, there are 3 chapters with 19 regulations explaining how to prevent air pollution from ships. The regulations in this annex mainly aim to determine the limitation on the Sulphur Oxide (SO) and Nitrogen Oxide (NO) emissions from ship due to their danger to the environment and humans (IMO, 2011). Besides, it prohibits deliberate emissions of ozone depleting substances. The regulations of Annex VI has been ratified by 87 contracting states since 2005 which, at the present time, covers 95.69% of the world tonnage (IMO, 2016).

In order to improve the regulation in response to the environmental change and economic situation, the regulations of each annex have been amended continuously, as presented in Table 2.3.

Table 2.3 Amendment of MARPOL 73/78

Year of amendment	Issue of amendment
1985	Annex II
1985	Protocol I – incident reporting
1987	special area extension
1989	Annex II
1989	North Sea special area
1990	HSSC amendments
1990	IBC Code amendments
1990	Annexes I and V – Antarctic as special area
1991	Wider Caribbean as special area
1992	Double hulls made mandatory
1994	Implementation
1995	Garbage records
1997	North West European waters as special area
1999	Persistent oil
2000	Deletion of tainting
2001	Revised 13 G (double hulls)
2003	Double hulls
2004	Revised Annex IV (sewage)
2004	Revised Annexes I and II
2005	North Sea SECA, Annex VI amendments
2006	Oil fuel tank protection
2006	South Africa special area, revised Annex III
2008	Revised Annex VI
2009	STS transfer, oil residue
2010	North American waters, Antarctic oil
2010	Revised annex III
2011	Energy efficiency
2012	Small islands regional reception facilities plan

Source: International Maritime Organization (2016: 99-168)

2.1.2 Annex V of MARPOL 73/78

The focal point of this study is the ship-generated garbage, which is listed and described as waste in the Annex V of MARPOL 73/78, officially called Regulations for the Prevention of Pollution by Garbage from Ships. As shown in Table 2.2, this annex entered into force on 31st December 1988 and, in this day and age, there are 151 contracting parties ratifying these regulations (IMO, 2016). Basically, the regulations in this annex identify the specific types of ship-generated garbage and determines the distances from land that they can be legally discharged into the sea. To control the disposal at sea, the regulations broadly classify the sea areas into 2 cases – inside and

outside the special areas, in order to specify the regulations for each area. Despite of the fact that some types of garbage from ship are allowed to be disposed of in the ocean in the required form and condition, the plastic garbage is the only sort of garbage that is banned from dumping into the sea.

In Annex V, there are 9 regulations with one Appendix presenting the form of garbage record book. Likewise, the regulation 1 aims to clarify the definition of jargons found in this annex such as garbage, nearest land and special area. According to the regulation, "garbage" means "*all kinds of food wastes, domestic wastes and operational wastes, all plastics, cargo residues, incinerator ashes, cooking oil, fishing gear, and animal carcasses generated during the normal operation of the ship and liable to be disposed of continuously or periodically except those substances which are defined or listed in other Annexes to the Convention, and it does not include fresh fish and parts thereof generated as a result of fishing activities undertaken during the voyage, or as a result of aquaculture activities which involve the transport of fish including shellfish for placement in the aquaculture facility and the transport of harvested fish including shellfish from such facilities to shore for processing*" (IMO, 2011). This definition will enable the related stakeholders, such as port state control, ship operator, ship master, crew and port operator, etc., to identify the right garbage and to adopt an appropriate solution for such the garbage. The next jargon is the term "nearest land" which is set up in order to determine the criteria for disposing of garbage at sea. In this regulation, the nearest land refers to "*from the baseline from which the territorial sea of the territory in question is established in accordance with international law…*" (IMO, 2011). The last term is "special area", which means "*a sea area where for recognized technical reasons in relation to its oceanographical and ecological condition and to the particular character of its traffic the adoption of special mandatory methods for the prevention of sea pollution by garbage is required. Special areas shall include those listed in regulation 5 of this Annex*" (IMO, 2011).

Afterwards, the regulation 2 specifies the situation that should apply the regulations of Annex V of MARPOL 73/78. The regulation states that "*unless expressly provided otherwise, the provisions of this Annex shall apply to all ships,*" which means that the regulations of Annex V should be adopted to all ships in any situation. The disposal of garbage outside special areas is explained in the regulation 3 of this annex. Generally, the plastic garbage is not permitted to be discharged into the sea in any cases, while the other types of garbage should be dumped into the sea as far as possible from the nearest land. Specially, the garbage other than plastic can be disposed into the ocean if the requirements are satisfied: 1) the dunnage, lining and packing materials, which will float, must be disposed at least 25 nautical miles from the nearest land; and 2) the food wastes and all other garbage including paper products, rags, glass, metal, bottles, crockery and similar refuse must be disposed at sea at least 12 nautical miles from the nearest land (IMO, 2011). However, there are special requirements for the disposal of garbage from the platforms in regulation 4. It states that there is no permission for the disposal of garbage from fixed or floating platforms engaged in the exploration, exploitation and associated offshore processing of sea-bed mineral resources, or from all other ships when alongside or within 500 meters of such platforms (IMO, 2011). Another special requirement is food waste from the platform that may be permitted to be disposed into the sea after it has passed through a comminuter or grinder from such fixed or floating platforms located more than 12 nautical miles from the nearest land,

as well as from all other ships when alongside or within 500 meters of such platforms. Such comminuted or ground food wastes shall be capable of passing through a screen with openings no greater than 25 millimeters (IMO, 2011). Different from those applied outside the special area, the regulations for the disposal of ship-generated garbage inside the special area are very strict. These regulations are included in regulation 5 of Annex V. Despite of the fact that the disposal is relatively strict regulated inside and outside the special area, the exception for the application of the regulations of Annex are described in regulation 6. In summary, there are 3 cases for this exception including 1) the discharge of garbage into the sea is aimed to secure the safety of a ship and those on board or saving life at sea, 2) the escape of garbage resulting from damage to a ship or its equipment provided all reasonable precautions have been taken before and after the occurrence of the damage, for the purpose of preventing or minimizing the escape, and 3) the accidental loss of synthetic fishing nets, provided that all reasonable precautions have been taken to prevent such loss (IMO, 2011). However, as this regulation of MARPOL was revised continuously, the most updated regulation, which entered into force on 1 January 2013, of disposal of garbage into the sea is summarized in Table 2.4.

Table 2.4 Garbage disposal by garbage type according to revised Annex V of MARPOL 73/78

Garbage type[1]	All ships except platforms[2]		Offshore platform located more than 12 nm form the nearest land and ships when alongside of within 500 meters of such platforms Regulation 5
	Outside special areas Regulation 4 (Distances are from the nearest land)	Within special areas Regulation 6 (Distances are from nearest land or nearest ice-shelf)	
Food waste comminuted or ground[3]	**≥ 3 nm, en route and as far as practicable**	**≥ 12 nm, en route and as far as practicable[4]**	**Discharge permitted**
Food waste not comminuted or ground	**≥ 12 nm, en route and as far as practicable**	**Discharge prohibited**	**Discharge prohibited**
Cargo residues[5,6] not contained in washwater	**≥ 12 nm, en route and as far as practicable**	**Discharge prohibited**	**Discharge prohibited**
Cargo residues[5,6] contained in washwater	**≥ 12 nm, en route and as far as practicable**	**≥ 12 nm, en route and as far as practicable** (subject to conditions in regulation 6.1.2)	**Discharge prohibited**
Cleaning agents and additives[6] contained in cargo hold washwater	**Discharge permitted**	**≥ 12 nm, en route and as far as practicable** (subject to conditions in regulation 6.1.2)	**Discharge prohibited**
Cleaning agents and additives[6] in deck and external surfaces washwater	**Discharge permitted**	**Discharge permitted**	**Discharge prohibited**
Animal carcasses (should be split or otherwise treated to ensure the carcasses will sink immediately)	**Must be en route and as far from the nearest land as possible.** Should be > 100 nm and maximum water depth	**Discharge prohibited**	**Discharge prohibited**

Garbage type[1]	All ships except platforms[2]		Offshore platform located more than 12 nm form the nearest land and ships when alongside of within 500 meters of such platforms Regulation 5
	Outside special areas Regulation 4 (Distances are from the nearest land)	Within special areas Regulation 6 (Distances are from nearest land or nearest ice-shelf)	
All other garbage including plastics, synthetic ropes, fishing gear, plastic garbage bags, incinerator ashes, clinkers, cooking oil, floating dunnage, lining and packing materials, paper, rags, glass, metals, bottles, crockery and similar refuse	**Discharge prohibited**	**Discharge prohibited**	**Discharge prohibited**
Mixed garbage	When garbage is mixed with or contaminated by other substances prohibited from discharge or having different discharge requirements, the more stringent requirements shall apply		

Source: IMO Res. MEPC.201(62)

[1] When garbage is mixed with or contaminated by other harmful substances prohibited from discharge or having different discharge requirements, the more stringent requirements shall apply.

[2] Offshore platforms located 12 nm from nearest land and associated ships include all fixed or floating platforms engaged in exploration or exploitation or associated processing of seabed mineral resources, and all ships alongside or within 500 m of such platforms.

[3] Comminuted or ground food wastes must be able to pass through a screen with mesh no larger than 25 mm.

[4] The discharge of introduced avian products in the Antarctic area is not permitted unless incinerated, autoclaved or otherwise treated to be made sterile.

[5] Cargo residues means only those cargo residues that cannot be recovered using commonly available methods for unloading.

[6] These substances must not be harmful to the marine environment.

Apart from the regulations placed on the control of garbage from the routine operation and the casualty of ships, the government of each party to the Annex V of MARPOL convention is required to ensure that the garbage reception facility is adequately provided at ports and terminals, without causing undue delay to ships, and according to the needs of the ships using them (IMO, 2011). The regulation 7 indicates the significant role of seaports on the marine pollution prevention from ship-generated garbage. Furthermore, based on the regulation 8, the party is urged to authorize the officers for inspecting the ships when there are clear grounds for believing that the master or crew is not familiar with essential shipboard procedures relating to the prevention of pollution from garbage (IMO, 2011). The ships that do not comply with the regulations of MARPOL 73/78 should be controlled by port until all regulations are satisfied (IMO, 2011). Finally, the garbage management plans and garbage record-keeping are described in the regulation 9 of Annex V. Basically, this regulation states that "*every ship of 12 m or more in length overall shall display placards, which are written in the working language of the ship, which notify the crew and passengers of the disposal requirements of regulations 3 and 5 of this Annex*" (IMO, 2011). In addition, "*every ship of 400 tons gross tonnage and above, and every ship, which is certified to carry 15 persons or more, shall carry a garbage management plan, which the crew shall follow. This plan shall provide written procedures for collecting, storing, processing and disposing of garbage, including the use of the equipment on board. It shall also designate the person in charge of carrying out the plan. Such a plan shall be in accordance with the guidelines developed by the Organization and written in the*

working language of the crew" (IMO, 2011). All ships are also required to provide the Garbage Record Book that corresponds to the form specified in the Appendix to this annex (IMO, 2011).

2.1.3 Ensuring the adequacy of port waste reception facilities

In spite of the fact that the adequacy of reception facility is mentioned in regulation 7 of MARPOL 73/78, the practitioners still encounter the difficulty in maintaining the adequacy, as it has a broad meaning and depends on many factors (Olson, 1994). Therefore, in 2000, the Marine Environment Protection Committee (MEPC) developed the Guidelines for Ensuring the Adequacy of Port Waste Reception Facilities based on the regulation of MARPOL 73/78 and United Nations Convention on the Law of the Sea (UNCLOS) so as to clarify by what means to manage the reception facility in the appropriate way. The obligations of states under the regulation of MARPOL 73/78 was already discussed in 2.1.1, while those under UNCLOS was described in *Article 192,* which indicates that "*states have a general obligation to protect and preserve the marine environment*", and any measures as well as the practical means at the states' disposal and according to the states' capability should be developed so as to minimize the possible pollution from ship *(Article 194)*. Besides, the flag states has the obligation to develop the national laws and regulations, which have at least the same effect as that of the international law and regulations *(Article 211 (2))* (IMO, 2000). According to the Guidelines, the adequacy can be basically ensured by providing the reception facilities that can receive all types and any volume of waste from ships (IMO, 2000). Furthermore, the scope of adequacy is extended to cover those used by mariners, which fully meet the needs of the ships that are regularly using them, do not provide mariners with a disincentive to use them, and contribute to the improvement of the marine environment (IMO, 2000). While operating them, port authority or the reception provider should take the operational need of the shipping firms into account, such as time concern, etc. The transfer time of waste should be mutually agreed in advance and take place during the port's working hours unless the ship's normal call at port is not within the working hours. Any barriers obstructing the shipping firms to use the reception facilities should be eliminated. The logistical and economic concerns of the ship operators need to be taken into account, since poor logistics performance of reception facilities can discourage the firms to use them.

The location of reception facilities is also important. Poor location, complicated procedure, restricted ability and unreasonably high cost for the service can dissuade the shipping firms to use the facilities. Moreover, port waste management should be made in advance prior to the ship arrival. This means that the information regarding the waste of the shipping firms should be submitted in advance to port (IMO, 2000). This cannot be accomplished without the consultation and collaborations between the port and the shipping firms. The periodic investigation on the operation of reception facilities is vital for ensuring their adequacy, so that the drawback can be found and eliminated in time. Moreover, port authorities should consult with the governmental agencies regarding how to treat or dispose of waste in the environmentally friendly manner, in order to enhance their capability in preventing marine pollution. Once all the processes are completed, the environmental performance of the reception facility, port waste management and disposal and treatment, etc., should be evaluated in order to explore the way to further improve the operation of reception facilities. This evaluation should

be included in the firms' strategy and synchronized with the plan of the shipping firms (IMO, 2000).

Apart from the operation of reception facilities, port and flag states are required by this guidance to undertake that all the requirements of the regulations of MARPOL 73/78 are fulfilled by the implementation of port operators, shipping operators, ship masters, crews, reception facility providers and terminal operators and so on. Normally, if the port and flag states are the same, the solutions for the inadequacy of reception facilities should be directly placed on such ports. Contrarily, if the flag and port states are different, flag state should inform the port sate of the inadequacy of reception facilities. Furthermore, to attain the requirements of MARPOL, the flag state is urged to provide the supervision to ships flying its flag, examine onboard arrangements during inspection, investigate infringements and prosecute offenders. Likewise, port state needs to ensure that the national legislation provides the appropriate power and create the environment that support the implementation and enforcement of the regulations of MARPOLL 73/78. Those, who fail to comply with the national regulations or of MARPOL 73/78, should be prosecuted by port state (IMO, 2000).

Corresponding with the guidance, the adequacy of reception facilities depends on the regional and industrial collaborations. The former type of collaborations can enhance the use of reception facilities through the mutual agreement on the cooperation on implementing an incentive price of the facility service and sharing information. The latter form of collaborations will allow port authorities, shipping firms and other parties to work more closely. This cooperative environment enables them to better understand the processes of each other and identifies the operational problems and then provides the right solutions (IMO, 2000).

According to the discussion above, the vital factors affecting the adequacy of the reception facilities are 1) the ability of reception facilities to receive all types of waste at any amount, 2) fully meet the needs of the ships regularly using them, 3) do not provide mariners with a disincentive to use them, 4) contribute to the improvement of the marine environment, 5) provide good logistics and economic performance, 6) provide consultation, negotiation and collaborations, 7) appropriate power exercise of regulators, 8) periodic investigation the operation of reception facilities and 9) advance submission of notification form. This set of parameters are considered as the critical factors determining the performance of reception facilities of the seaport. Therefore, they are included in the analysis.

2.1.4 Good practice for port reception facility providers and users

In 2013, MEPC developed the guideline called "Guide to Good Practice for Port Reception Facility Providers and Users," which is based on the requirement of MARPOL 73/78 and the Guidelines for Ensuring the Adequacy of Port Waste Reception Facilities. This guidance aims to provide the good practices for addressing the inadequacy of port reception facilities. The ship operators, ship owners and port reception facility providers are the target of this guidance. The adequacy of reception facilities in this guideline is extended to cover the use by mariners, which fully meet the needs of ships that are regularly using them. Furthermore, the reception facilities should not provide mariners with a disincentive to use them, while they are required to contribute to the improvement of the marine environment. Corresponding with this

definition, it indicates that the economic benefit of the shipping firms and the environmental performance should be taken into account (IMO, 2013). Therefore, it is a good way for the shipping firms and reception facility providers to make an advance plan as it can minimize the delay, unexpected costs and improve environmental management practices (IMO, 2013). In addition, they are the great practices if the waste management strategies are integrated in the voyage, logistics and commercial planning. All plans should include the delivery of waste topic and eliminate the barriers that obstruct the shipping firms to comply with the requirement of MARPOL 73/78. Besides, the source of waste should be minimized by reducing the waste materials, such as packaging of cargo, etc. This can be attained by establishing an agreement with the supplier to accept the return of the packaging upon delivery (IMO, 2013). This sheds light on the important role of collaborations between partners. An increased familiarity with the ship's engine-room treatment systems along with the crew's training in waste management and recording will help reduce the amount of waste. The accessibility to the information regarding the regulations of ports of call and the procedure in using port reception facilities and so on is very vital, as it enables the shipping firms to plan in accordance with such requirements prior to the arrival of ship. During the transferring operation, the procedure in International Safety Management Code (ISM Code) should be followed so as to secure the safety of the ship and environmental standard. Likewise, port authorities should prepare the port waste management plan as well as ensure that relevant information about the reception facility services, such as type and capacity of the reception facilities, the contact point, associated cost, port authority, harbour master and a link to the port website, etc., are available in the accessible source. The advance notification should be submitted from the shipping firms to port authorities or reception facility providers in order that they can prepare the equipment and vehicle in advance when receiving waste from ships (IMO, 2013). Another aspect of good practices is to develop the procedure that facilitates better integration and collaborations between the shipboard and landside waste management practices, which will benefit in increasing environmental performance. However, this procedure should be in parallel with the standards for the Management and Handling of Shipboard Garbage as specified in ISO 21070 and the requirement of local authority (IMO, 2013). At the end of the delivery process, the reception facility provider should issue a waste delivery receipt (WDR) standardized by IMO to ship masters as the documentary evidence (IMO, 2013).

Corresponding with the discussion above, the parameters found in this guideline are common to those extracted in 2.1.3, as they are developed from the same basis. Thus, there is no list of parameters in this section in order to reduce the redundancy.

2.1.5 Port supply chain and shipping collaboration

This section aims to discuss the concept of supply chain management oriented in seaports. The driving factors, and by what means, supply chain management implemented in port operation are also explained, based on the previous literature. Furthermore, the success of supply chain management depends largely on the collaborations among the supply chain partners (Yang et al., 2013); therefore, this doctrine is the primary concept of this study, which is debated at the end of this section. The definition along with the parameters indicates the characteristics of the shipping collaborations, which are gathered from the leading studies so as to objectify the word collaborations for the practitioner and scholars.

2.1.5.1 Port supply chain

Port supply chain is the combined concept between “port” and “supply chain”, indicating the adoption of supply chain management in the operation and administration of ports which changes how port authorities and terminal operators manage their services from focusing on the fragmented performances, such as operational performance, etc., to the supply chain and logistics performance (Tongzon, Chang, and Lee, 2009). All port services are now aligned with the specification requirements of supply chain partners rather than individual firms. Identifying the value added activities for entire chain is critical for port authorities and terminal operators to maintain the competitiveness, because the shippers and the shipping lines will search for the ports of call that add value to their cargo with the lowest cost (Song and Panayides, 2008). Moreover, the supply chain management is very dynamic and sensitive to the shift of the uncontrollable factors, such as economy, technology and regulations, etc. Therefore, the modern seaports need to be agile and responsive to the dramatic change, of supply chain partners’ demand (Song and Panayides, 2008). To attain these goals, port managers and port authorities need to build up trust with the shipping firms and shippers to underpin the collaborations, which are the key success factors to seaports’ competitiveness. Recently, the rising concern of public regarding environment drives seaports to take into account. The green practices are now oriented within organizations of many leading shipping lines and international terminal operators. Once the green shipping practices is attained at an organizational level, the green shipping integration with external partners can be performed. By doing this, the port competitiveness can be gained by enhancing the environmental performance, such as the reduction of material that becomes waste, the decreasing of fuel consumption and the reduction of time, etc. (Yang et al., 2013).

2.1.5.2 Port collaborations

The success of supply chain management, as discussed in 2.1.5.1, heavily depends on the integration between seaports and the shipping companies. However, the term of integration is relatively ambiguous in practice resulting in the difficulty to effectively implement. At the same time, there is the terminological confusion between the words “integration” and “collaborations” in the academic and practical fields. Therefore, this section aims to clarify the definitions of these two jargons and then sheds light on the significant role of collaborations on the success of port supply chain management. At the end of this section, the parameters indicating the characteristics of collaborations are discussed based on finding of the previous literature.

Song and Panayides (2008) defined the integration as “*to the extent to which separate parties work together in a cooperative manner to arrive at mutually acceptable outcomes,*” which corresponds to the definition provided by Tongzon et al. (2009). In accordance with this definition, the vital aspects of integration are 1) mutual attempt from separated parties, at least 2 parties, other than an individual effort of a particular firm, 2) working together between parties based on the cooperative manner refers to the organizational interaction between parties, and 3) aiming to attain the mutual acceptable outcomes indicating that the common goal as well as the benefits

must be determined and shared between firms. These 3 main characteristics are claimed as the vital elements of integration, which is a significant factor affecting the success of supply chain management. Without integration implies disconnection from business partners, which is impossible for the entrepreneurs to let it happen. Based on the definition, the more integration between partners indicates the more they work together to accomplish the mutual objectives such as mutually identify 1) the solutions for product and service production, 2) the ways to reduce transportation cost and 3) the means to reduce lead time, etc. By doing this, the integrated partners can mutually gain competitiveness through the aforementioned benefits.

Another popular word found in the literature is collaborations. This word has been widely adopted to indicate the collaborative operation and management between 2 partners or greater than 2. While scholars and practitioners have witnessed the terminological ambiguity over the decades, Cohen and Roussel (2005) seem to be one of the first groups who clarified the word collaborations based on their long experience in different industries. They defined this jargon as "*by what means the companies in supply chain work together towards mutual objective through the sharing of ideas, information, knowledge, risks and rewards*" (Cohen and Roussel, 2005). Based on this definition, 3 main features of integration are commonly shared by the word collaborations. They still indicate the mutual attempt of parties in working together so as to accomplish the mutual objective. Nevertheless, the additional aspects are included in the definition of collaborations. Firstly, they obviously aimed to extend the adoption of collaborations to cover the working among the supply chain partners who oblige to add value to the cargo for the final customers' satisfaction, while the word integration uses the word "parties", which do not indicate the business bond as tight as those in supply chain. Another expression adding into collaborations is the achievement of mutual objective must be based on the resource sharing such as ideas, information and knowledge. This indicates that the collaborative partners tend to depend on their partners' capability. Therefore, they need to assist one other in developing their performance. The information technology system is required to support the collaborative mission. Moreover, the words "risk" and "reward" in the definition of collaborations imply unity of partners in sharing negative consequences from collaborations. This forces them to spontaneously work more closely to identify the solution for dealing with risk. Likewise, the sharing of reward expresses that the success of work will benefit them equally or fairly. This win-win situation will attract all supply chain partners to further collaborate with one other. The assistance between them will naturally take place as they know that the capability of their partners will increase the mutual benefits. This will lead to the sustainable business strategy.

Corresponding with the discussion above, the words "integration" and "collaborations" can be adopted interchangeably. However, the meaning of collaborations 1) covers broader range of academic and practical applications, 2) heavily emphasizes the solid bond between collaborative partners rather than the general business parties, 3) obviously indicates the partners' obligation in sharing resources and developing system to support the resource sharing, and 4) indicates the dependency on the partners' capability, etc. Moreover, collaborations implies the win-win situation, which is the sustainable strategy rather than the integration. Therefore, the word "collaborations" will be used in all parts of this paper because the focal

partners of this study are seaports and shipping firms, who work closely in adding value to cargo by sharing resources, information, risk and reward.

2.1.5.3 Shipping collaborations

Based on the aforementioned discussion, the major characteristics of collaborations are drawn to develop the definition of green shipping collaborations (GSC) in this study. Therefore, the GSC is defined by this study as *how the shipping companies work together towards mutual green objective through the sharing of ideas, information, knowledge, risks and benefits*. According to this definition, a few issues need to be clarified. These are the meaning of shipping companies and their supply chain partners, green objective and resource sharing.

As it is well known that sea carriers act as the intermediary between importers and exporters, while seaports serve as the facilitator between sea and land transportations. This causes a difficulty in defining the exact supply chain partners of the shipping companies. Fortunately, Yang et al. (2013) identified the role of the shipping-related companies in their work. They argued that the external partners of the shipping firms such as the fuel company, the container company and the shipbuilding company, etc., are considered as the suppliers, as they are responsible for only submitting the shipping material and equipment, in order to enable the liner firms to operate. Contrarily, the partners, such as seaports, terminal operators, trucking company, stevedoring company and so on, are classified as the supply chain partners of the shipping firms, as they mutually add value to the cargo passing through them, while the main customers of the liner firms are shippers and freight forwarders (Yang et al., 2013). Based on the theory above, shipping firms refer to the liner shipping companies, who are in charge of transporting cargo from one port to other ports, proceeding customs clearance and packing. The variety of services depends on their business mission. The supply chain partners of the liner shipping firms mean those who add value to the cargo passing through them, such as seaports, terminal operators, trucking company, stevedoring company and so on. The GSC might be developed between the liner shipping firms and their supply chain partners, supplier and customers depending on the collaborative objectives such as 1) setting up the company policy and procedure that commit to take care of environment and society through the environmentally friendly operation, 2) adopting the paperless shipping documentation, 3) using environmentally friendly shipping equipment, 4) cooperating with shipper for using recycle packaging, 5) cooperating with shipping suppliers in using recyclable shipping material such as packaging, line and carton etc., 6) adopting the shipping designs in comply with the environmental regulations, 7) optimizing the shipping route in order to minimize the pollution, fuel consumption and so on (Lai et al., 2011). However, this study concentrates on the GSC between Laem Chabang Port and liner shipping companies relating to ship-generated garbage and garbage reception facility such as management, operation, regulatory requirement and process design and so on.

The second issue is the green objective of GSC. In this study, green objective refers to the desire to increase the environmental performance of the shipping firms such as the reduction of pollution from ports' and vessels' operation, the elimination of shipping material that becomes waste during transportation, the reduction of energy consumption onboard and onshore and the increase of clean fuel

energy of onboard, etc. The aim to create the positive benefits to society and environment is also included as the green objective, such as giving education to seafarers about marine pollution prevention, conducting research in an advancement of technology for reducing pollution from operation, and developing the organizations' culture in protecting marine environment. The last topic is resources sharing between supply chain partners to attain green benefits. The resources that need to be shared are supposed to be green resources, which refer to any resources that can increase the environmental performance once they are shared. For instance, information about the amount of waste needed to be disposed at seaports should be shared from the shipping firms in order that seaports can prepare the reception facilities more adequately, whereas the exchange of the up-to-date knowledge regarding pollution prevention can enable seaports and shipping forms to increase their environmental performance. Moreover, the sharing of new seaports' regulations and procedures will allow the shipping firms to plan more precisely. By doing this, the collaborative partners can gain benefits from resource sharing.

2.1.5.4 Levels of collaborations

The collaborations between partners in this study are based on the theory of Cohen and Roussel (2005). Corresponding with the doctrine, the collaboration partners in supply chain normally are 1) customers, 2) materials suppliers, and 3) suppliers of services that support supply chain operations. The collaborative associations are established and maintained in common ways, despite the fact that each group requires a slightly different management approach. Generally, the collaborations between partners are not equally created and have very distinct characteristics. The results of collaborative relationships may vary widely from one set of partners to another (Cohen and Roussel, 2005).

Figure 2.1 presents the various types of collaborative relationships and defines the basic characteristics of each. The horizontal axis plots the relative number of relationships, while the vertical axis measures the depth of collaboration. Based on this concept, they classified collaborations into four levels: 1) transactional, 2) cooperative, 3) coordinated, and 4) synchronized.

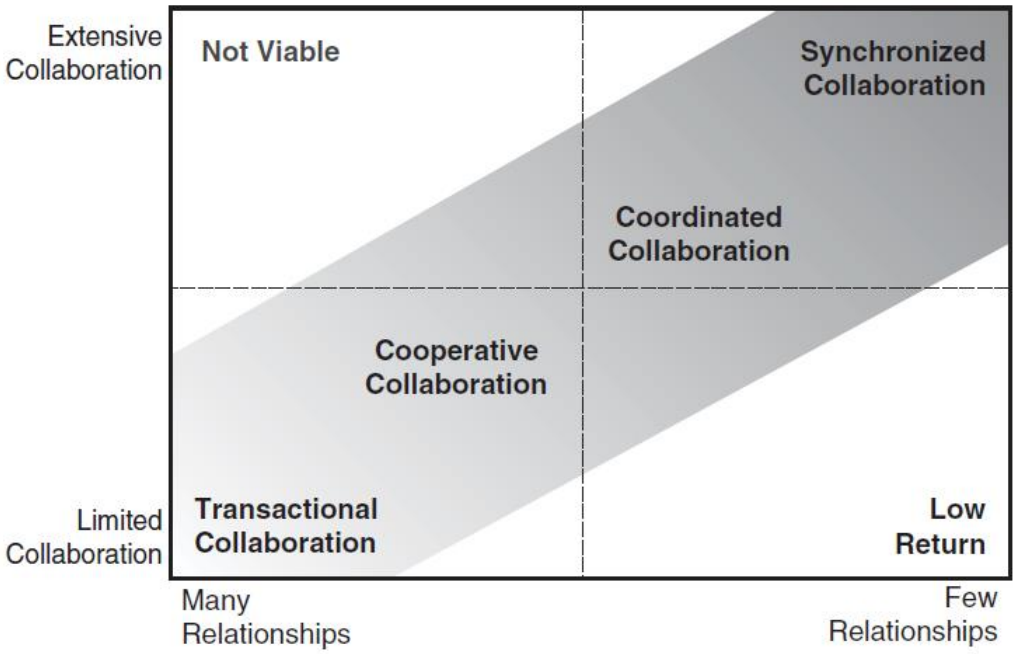

Figure 2.1 Collaboration spectrum
Source: Cohen and Roussel (2005: 143)

According to Figure 2.1, Cohen and Roussel (2005) created collaboration spectrum to indicate the levels of collaborations between supply chain partners. The boundaries between the different levels of collaboration are blurred, due to the fact that collaboration is a continuum, not a set of clearly delineated management practices. Note that the dimensions of the two axes comprised of the number and the depth of relationships are used simply to provide a clear graphic view of the collaboration spectrum (Cohen and Roussel, 2005). The other models can adopt different criteria, such as level of investment or dependence on technology, to describe the depth and breadth of collaborative relationships. Overall, the levels of collaborations between partners are classified into 4 levels.

2.1.5.4.1 Transactional Collaborations

The objective of transactional collaboration is the efficient and effective execution of transactions between partners, but it does not mean that transactional relationships between supply chain partners offer no strategic value. Nevertheless, partners in a transactional relationship rarely concentrate on reducing supply chain management costs or increasing revenues. The focal point is normally on improving the ease at which transactions are conducted. With less strategically considerable supply chain partners, companies tend to focus on minimizing the effort associated with day-to-day transactions rather than on developing long-term relationships. Transactional relationships rarely require complicated information systems. Indeed, many companies involved in this type of relationship lack the systems and infrastructure needed to provide and respond to information electronically. Because of this, many transactions are manual (Cohen and Roussel, 2005).

2.1.5.4.2 Cooperative Collaborations

The partners in cooperative associations have a closer relationship through a higher level of information sharing. They may provide automatic commitments and confirmations, or share information on forecasts, inventory availability, purchase orders, or order and delivery status. The push system or a one-way communication is generally used between partners. In cooperative collaborations, the types and format of data provided usually are standardized and exchanged via more sophisticated technologies. The electronic data interchange (EDI) is the basic method of communication used in cooperative relationships. However, for companies without an EDI capability, Internet-based supplier portals or extranets are an excellent alternative. Most of these tools enable document and content management and include embedded workflows to automate the routing of documents, forms, and certain data and tasks (Cohen and Roussel, 2005).

2.1.5.4.3 Coordinated Collaborations

In a coordinated relationship, supply chain partners work more closely together and depend more on each other's capabilities. As such, a coordinated relationship requires a two-way flow of information between partners and tightly synchronized planning and execution processes. Because the infrastructure and processes needed to support this type of information sharing are more complex than in the cooperative model, coordinated collaborations are usually reserved for more strategically critical supply chain partners. Unlike transactional and cooperative relationships, coordinated collaboration requires a high level of negotiation and compromise. Given the more strategic nature of these partnerships and the high level of data sharing, proprietary systems are needed for exchanging information. Because of this complexity, a coordinated relationship requires a long-term commitment by both partners and is rarely undertaken lightly. Putting the required processes and tools in place takes time and money; the expectation is that both parties will benefit from the expected efficiencies created as part of the ongoing execution of the relationship (Cohen and Roussel, 2005).

2.1.5.4.4 Synchronized Collaborations

The highest level of collaborations between partners are synchronized collaborations. The collaborative relationship in this model moves beyond supply chain operations to include other critical business processes. Partners generally invest in joint research and development projects, supplier development, and intellectual property (IP) development. Both physical and intellectual shares of assets may even extend to personnel share. Synchronized collaborations are often called strategic alliances. In a synchronized relationship, information is developed jointly rather than just transmitted or exchanged. Furthermore, synchronized collaboration tends to focus on a strategic vision of the future rather than on near term planning and tactical execution. Development projects that consider supply chain requirements when developing the product strategy are good examples of synchronized collaborations.

2.1.5.5 Benefits of shipping collaborations

The impacts of shipping collaborations vary depending on the characteristics of collaborative projects between supply chin partners. However, based on the literature review, it is found that the supply chain partners will gain benefits from GSC rather than negative impacts. The contribution of GSC on the shipping firms includes cost reduction (Lai et al., 2014; Li, Wang, and Cook 2015; Rodrigues et al. 2015), increasing good relationship with partners (Lam, 2011), operation planning improvement (Ascencio et al., 2014; Talley, Ng, and Marsillac, 2014), good public reputation (Hall et al., 2013), regulatory compliance (Hall et al., 2013), expansion of business (Parola et al., 2014), competitiveness of shippers, shipping firms, and seaports (Talley et al., 2014; Li et al., 2015), innovation (Panayides and Lun 2009; Hall et al., 2013), increase in environmental performance (Hall et al., 2013; Gibbs et al., 2014; Lai et al., 2014; Lai and Lam, 2015; Li et al., 2015; Rodrigues et al., 2015), increase in cargo throughput (Parola et al., 2014), and supply chain performance enhancement (Panayides and Lun, 2009; Lam and Yap, 2011). In spite of the fact that a number of GSC benefits were well documented by many scholars, obtaining these benefits is not an effortless task as there are many barriers. Tongzon et al. (2009) argued that the relationship between seaport and liner shipping forms is critical for the success of supply chain collaborations. The poor association between shipping partners will obstruct them from sharing critical information and resources. This will disable seaports to generate the accurate plan. Therefore, finding a strategy to build up good relationships with partners is the first task of the shipping firms and seaports. Furthermore, trust between partners was claimed by Panayides and Lun (2009) as another significant factor on the willingness to share information and the desire to mutually develop green innovation, such as totally new or adjusted product, services, procedure, system and technology introduced by the firms can avoid or reduce environmental damage (Panayides and Lun, 2009). If the firms fail to build up the trust with partners, they will lose an opportunity to generate collaborations and unable to gain environmental performance and competitiveness. Focusing on the self-interest is another barrier to generate the collaborative relationship with partners as it impair the win-win situation (Lam et al., 2013). The partners should concentrate on mutual interest and distribute the fair benefits to all supply chain partners. The unfairness of interest can discourage partners from developing collaborations. The internal green practices in the shipping organization is also considerable on the success of external integration, green performance and competitiveness (Yang et al. 2013). Yang et al. (2013) argued that the external green integration and green performance act as the intermediary between the internal green collaborations and the firms' competitiveness. This means that it is impossible for the shipping firms to attain the external green collaborations with partners, if they fail to deploy green practices in their organization. All green policy, implementation and culture should be integrated among organizational departments prior developing green external integration. Furthermore, the failure of the green external integration will reduce the environmental performance of the firms which diminish the firms' competitiveness. Thus, Yang et al. (2013) recommended that the shipping firms should attain green practices in the organization prior to building up external green integration. By doing this, the shipping firms and partners can enhance the environmental performance, which results in the higher competitiveness (Yang et

al., 2013). Another substantial factor on the accomplishment of collaborations is the value adding of activity. The work of Song and Panayides (2008) indicates the bilateral relationship between value adding and collaborations. On the one hand, the partners can assist each other in identifying ways to add value to product and services in order for satisfying the final customers and increasing supply chain competitiveness. On the other hand, the activity that needs collaborations must be worthy enough for the collaborative partners to invest their budget and effort. If the collaborations do not provide the impressive return in terms of profit, cost reduction, increase the speed of the service and other competitive advantages, it is laborious for convincing the supply chain partners to generate collaborations. Moreover, Lai et al. (2011) argued that the green practices depend on the strong enforcement of environmental regulations and laws of the regulators, while the international regulations lack enforcing and monitoring systems (Knapp and Franses, 2009). Based on this argument, the motivation of supply chain partners to generate the external green collaborations can be affected by the regulatory factor. Hence, domestic and international laws should be taken into account when analyzing collaborations. In addition, the request of the customers can persuade the shipping firms to provide a green operation. Due to the increasing of environmental concern of public, the shippers, especially those in the industry that environmental performance is vital such as food industry etc., will seek for the ports of call and the sea carriers that have a good environmental record (Lai et al., 2011). Therefore, the shipping firms, such as K-Line, Maersk, NYK and OOCL and so on tend to develop green collaborations with shippers and their partners such as seaports and terminal operators, etc., in order to clean product and sustainable transportation (Lai et al., 2011).

2.2 Review of the Literature

The review of previous literature was mainly aimed to 1) examine the existing knowledge regarding the ship-generated garbage management, port supply chain and green shipping collaborations and other related studies, 2) identify the gap in the current literature that can be added value by this study, 3) extract the parameters that can be adopted by this study, and 4) draw the possible causation to support the analytical process. A series of related studies from the late 1900s to 2016 were brought from different online sources such as ScienceDirect, Elsevier, tandfonline by Routledge and so on which are undertaken by the Office of the Higher Education Commission. This study classifies the related literature into 3 main groups: 1) the study in ship-originated garbage management; 2) the study in port supply chain and integration; and 3) the study in green shipping supply chain and collaborations. The detail of each group is discussed as the following.

2.2.1 Study in ship-originated garbage management

A review of literature over the past forty years indicates that a number of studies concentrated on ship-generated garbage in different viewpoints while a very limited attention was paid on the study of operational waste generated from ship. Generally, a series of studies since the early 1970s can be classified into 2 groups: an impact assessment with exploration of cause (Horsman, 1982; Vauk et al., 1987; Laist, 1987; Jones, 1995; Rees et al., 1995; Henderson, 2001; Derraik, 2002; Carpenter et al., 2005; Butt, 2007; Georgakellos, 2007; Cho, 2009; Knapp et al., 2009; Ng et al., 2010), and a

study or review on how to cope with ship-originated garbage (Waldichuk, 1973; Olson, 1994; Bateman, 1996; Ball, 1999; Polglaze, 2003; Ulnikovic et al., 2012; Chen et al., 2013).

Most of the studies in the former group aim to investigate the impact of ship-originated garbage on marine environment and wildlife. Starting in 1987, Vauk et al. (1987) monitored the accumulated garbage on the coastline and found that most garbage come from shipping source. At the same time, Laist (1987) reviewed literature on biological effect from the discarded plastic debris in aquatic environment. The conclusion pointed out that marine biology problem can be aggravated by deleterious consequences of debris. Many years later, the effects of debris on marine creatures and surrounding systems were discussed in the study of Jones (1995). He depicted how various types of negative externality were generated from fishery vessel including injury of human, loss of economy and ship. In the similar period of time, Rees et al. (1995) highlighted the role of monitoring scheme on the assessment of impacts of a legal enforcement on the amount of marine debris. Many means of surveys were reviewed in the study and, finally, an effective survey for a particular purpose was recommended. In 2002, the summary of Laist (1987) was agreed by Derraik (2002) that plastic debris dumped into the sea by ships can substantially harm marine animals in different ways, such as entanglement and digestion, etc. Apart from the danger of ship-generated garbage, Butt (2007) argued that its volume also harms marine environment of the world, especially from mega cruise vessels, due to its large consumption of passengers. Potential effects of food garbage were heavily discussed in his study. It is noticed that most of the above studies also estimated the amount of ship-generated garbage and predicted the likely volume of garbage illegally dumped into the sea by shipping fleet at that time (Horsman, 1982; Vauk et al., 1987; Polglaze, 2003).

Instead of assessing the impacts on marine environment, some scholars paid attention on analyzing the effect of laws on the amount of marine pollution, casualty or behavior of ship operators. An initial attempt can be explored in the study of Horsman (1982). He monitored the number of consumed items on board the ship compared to the number of garbage delivered at the destination port. It was found that ship-originated garbage was illegally discharged into the sea and, ultimately, he concluded that ship operators ignored the regulation. This finding relatively contradicted the expectation of Vauk et al.(1987) that believed that the international regulation can reduce the marine pollution generated from ships. Almost a decade later, Henderson (2001) investigated the effects of an enforcement of MARPOL 73/78 on the reduction of marine entanglement. The result showed that there was no difference between before and after the implementation of the regulation. Likewise, Carpenter et al. (2005) surveyed the effects of EU regulation on the number of reception facilities at ports and their survey showed that no increase was found. However, they argued that it was due to the fact that port reception facility was already available prior to the introduction of the directive 2000.

According to the discussion above, it is noticed that the international laws barely seem to have an effect on the prevention of marine pollution. The reason can be found in the study of Knapp et al.(2009). They explained that it is due to the fact that the international regulator, for instance, International Maritime Organization lacks power to enforce and does not monitor the performance of the state members. However, this problem can be remedied by increasing an enforcement of conventions through an

increasing number of ratifying members. Another solution to solve this problem was suggested by Georgakellos (2007) and Cho (2009). The former argued that ports should implement a reasonable charging system, while the latter recommended carrying out an incentive program. These findings were claimed as an effective means for an improvement of legal compliance of marine polluters.

Another characteristic found the previous studies is reviewing the ways to improve an ability to prevent marine pollution from ship-originated garbage. Waldichuk (1973) seems to be the first scholar, who shed light to the attempt in preventing marine pollution. A development of international regulations regarding marine pollution prevention from oil waste and other types of waste were heavily discussed in his work. However, no regulation of ship-generated garbage was discussed, due to the early age of legal development of that period. Twenty years later, Olson (1994) pointed out how ports play the considerable role in reducing marine pollution from ship-generated garbage through an adequate provision of port reception facilities. This finding corresponds to the conclusion of the study of Bateman (1996), which stated that port reception facilities can reduce marine pollution and marine debris in Australian ports, especially, if provided adequately. To explain how, Ball (1999) identified the ways to ensure an adequacy of port reception facilities to be kept all the time. He suggested that the sustainable ways is to educate shipowners regarding the need to discharge legally waste to reception facilities, while the size of reception facility, as the minimum requirement, should be taken into account.

In addition to the responsibility of ports in preventing marine pollution, seagoing ships were also recommended to equip storage on board and prepare a good garbage management plan (Olson, 1994; Ball, 1999; Polglaze, 2003). The concept of size of garbage reception facility presented by Ball (1999) was sharpened by Ulnikovic et al. (2012). They explained how to provide the appropriate capacity of reception facility at port based on the marine traffic at port in the Republic of Serbia. In spite of a great concept of this study, which can be used to guarantee an adequacy of reception facility, an opportunity to further develop their proposed estimation model can be found. For example, besides the number of ships, number of origins of garbage, number of passengers, and period of stay at port, etc., additional variables, which influence the amount of waste should be included in the analysis. Furthermore, the 1-year analysis of data will only reflect the marine traffic at port and the observed amount of waste for short horizon; it cannot depict the long-term trend in the future.

According to the discussion above, a huge attempt in addressing ship-generated garbage is explored in the previous literatures. Nevertheless, there is a void for the current study. Firstly, it is noticed that the operational waste generated from ship has not been studied by any scholars. This results in the deficiency of the content of operational waste in academic field. Secondly, some studies present how to estimate the amount of garbage generated on board by using an econometric model, which basically cannot be used for estimating the amount of garbage delivered at ports. Therefore, this study fills the gap by developing the model, using dominant factors on the amount of garbage delivered at port. In addition to the academic scarcity, the intrinsic hazard of operational waste to marine environment causes the finding of this study worthier because it can increase the ability of ports to achieve the goal of MARPOL 73/78.

2.2.2 Study in port supply chain and integration

As discussed in 2.1.5.1, an adoption of supply chain concept in seaport management heavily transforms the role of seaport from being the trading facilitators to the strategic partners in business chain. In the past, the velocity of cargo flow passing through seaports was the significant indicator for the liner shipping companies to call such the ports (Song and Panayides, 2008). This leads to the fact that the operational efficiency of seaports was the focal point of port authorities and scholars. The measures of port efficiency were based on cargo throughout, port facility capacity, port dwell time, port turnaround time and port tariff and so on (Song and Panayides, 2008). Nevertheless, the increasing role of supply chain management on the operational and managerial concept of shippers was the key factor driving seaports to synchronize supply chain doctrine with their operation and management. The performance indicators of seaports change from operational view point to logistics and supply chain perspectives (Song and Panayides, 2008; Vieira et al., 2015). The port services such as loading and discharging of cargo, providing temporary storage space and deploying customs clearance in port area, etc., are expected to add value to the final customers and to reduce the supply chain cost rather than the individual firms' cost. With this reason, Song and Panayides (2008) argued that seaports are no longer seen as the trade facilitator between countries or just as the interface linking maritime transport and inland transport. Currently, seaports become the strategic partner in supply chain adding value to cargo through a pack of port services to the final customers.

This new role of seaports attracts an interest of many scholars on the port supply chain study. Song and Panayides (2008) seem to be the primary researchers who clearified how seaports integrate with supply chain partners. They identifed the parameters indicating the integration of seaport with supply chain including 1) the use of communication and information technology, 2) relationship with shiping line, 3) value added service, 4) association with inland carriers, 5) transportation mode integration and 6) channel integration. Besides, they analyzed its relationship with port competitiveness – price, quality, reliability, customization and responsiveness. It was found that the pair of variables indicates the positive relationship. This means that the more port integrate with partners, the more competitiveness port can gain (Song and Panayides, 2008). However, their finding did not present the details on how seaports can integrate with supply chain partners in practice. Thus, Tongzon et al. (2009) advanced this knowledge by analyzing how seaports can integrate with partners from 2 points of view – port operators and port users. Their results heavily correspond to those explored in the original research of Song and Panayides (2008). They explianed that a long term relationship between seaports and shipping lines will provide an opportunity for seaport to generate an innovation, reduce cost in shipping transaction, increase operation flexibility and enhance port responsiveness (Tongzon et al., 2009). Furthermore, they found that the value creation mainly stems from 1) reducing cost and 2) increasing responsiveness, hence, seaports need to recognize the actual expectation of the shipping firms through data integration which heavily depends on the information technology and the willingness to share the critical information partners (Song and Panayides, 2008; Tongzon et al., 2009). Moreover, they argued that, without trust and royalty, it is difficult for seaports and the other partners to share the critical information and resources (Tongzon et al., 2009). Therefore, Panayides and Lun (2009) advanced this knowledge by conducting an empirical study on the effect of trust on the innovation

initiation and supply chain performance. They found that "trust" is considered the significant fundamental for developing the higher level of collaborations because it positively supports the partners' decision making to share more critical information with seaports which will enable them to better understand the need of the shipping firms and provide the service accordingly. In addition, the accessibility to the strategic information generates the collaborative environment between seaport and the shipping lines to mutually develop plans, and design processes and services that create a long term benefits to them (Panayides and Lun 2009). They; hence, argued that port managers should know the critical factors that can increase the trust of their partners, if they would like to attain higher integration. The knowledge of port integration was then improved by the work of Hoshino (2010). He suggested the strategic collaborations in the poor situation of Japanese ports, due to the loss of cargo throughput to the large Chinese ports. He recommended that instead of competing with one other, the neighboring ports in Japan should collaborate and develop port project under a single managerial plan. He believed that, by doing so, Japanese ports can mutually benefit from an increase of cargo flow (Hoshino, 2010). Likewise, the research of Hoshino (2010), Lam and Yap (2011) advanced the port collaborations concept by investigating, by what means seaports, terminal operators and shipping lines can benefit from the shipping service connectivity with seaports in the proximate area. They argued that it is likely for them to develop the shipping service package calling a set of seaports (Lam and Yap, 2011). At the same time, Lam (2011) advanced the collaborative pattern of supply chain through slot capacity analysis assigning seaport as a node and shipping lines as an arc linking between paired nodes. She found that the integration in maritime supply chain is vital for the vertical collaborations with suppliers and customers (Lam, 2011).

Based on the literature review, the maintenance of collaborative relationship is as important as the initiation of collaborations. Lam and Voorde (2011) developed the model enabling shipping lines to strengthen their collaborative association with partners. In addition, they also explored that the association in shipping business tends to transform from the customer-supplier relationship, of which is the traditional, to the synchronized relationship, which partners work more closely for long term benefits (Lam and Voorde, 2011). This indicates the need for the future study to investigate the synchronized strategy for seaport and shipping companies. A few years later, Ascencio et al. (2014) underpinned the collaborative doctrine of port logistics chain by developing the reference model based on the supply chain management. It was found that the model truly supported the collaborative decision making, in terms of infrastructure, common resources, and information (Ascencio et al. 2014). Furthermore, the work of Zhang and Lam (2014) emphasized the significance of seaports and maritime carriers to integrate with supply chain partners, due to the increasing role of logistics management. As maritime transportation is included in logistics service needed by modern shippers, this heavily drives seaports and shipping lines to smoothen their services with their partners through information sharing (Zhang and Lam, 2014). To attain this, the transactional information should be sufficiently shared by shippers from maritime providers to logistics service providers (LSP), in order that they can manage operation more efficiently. In addition, the strategic information such as production schedule, sale and marketing status of shippers and shipping firms should be submitted to LSP so as to increase the accuracy of forecast. Finally, the feedback

information of customers is vital for the improvement of the process and services. It should be continuously shared among supply chain parties so that they can identify a solution to solve the problem (Zhang and Lam, 2014). They also highlighted the importance of the information technology as well as trust on the success of information sharing which is one of the most significant factors on the achievement of integration (Zhang and Lam, 2014). This finding corresponds to the argument of Song and Panayides (2008), Panayides and Lun (2009) and Tongzon et al. (2009). Many years later, Talley et al. (2014) advanced the work of Song and Panayides (2008) by inspecting the performance of seaports based on the service network used by port operators. Their results still aligned with the original concept of supply chain, which means that seaports with more cooperative relationship with partners will gain competitiveness through a higher port efficiency (Talley et al., 2014).

Instead of investigating the relationship between port collaborations and competitiveness, Tovar, Hernández, and Rodríguez-Déniz (2015) further developed the knowledge by studying on the strategy for increasing port competitiveness. They argued that the customization and differentiation of port services for a particular shipper can provide an opportunity for seaports to be the regional hub or even global hub in the competitive environment (Tovar et al., 2015). However, to attain these strategy and goals, seaports need to solidify the connectivity with supply chain partners so as to possess the sufficient information which is necessary for port's service improvement and decision making. At the same time, Loh and Thai (2015) pointed out the unsatisfactory consequence from the failure of port service provision on supply chain partners by simulating scenarios from 4 treats – 1) avoidance of disruption, 2) mitigation of disruption, 3) deviation of transportation plan and 4) delays and deviation of transportation plan (Loh and Thai, 2015). It was explored that the port user might either witness the delay of port service or experience the increasing of cost, which drive them to search for a better alternative port. Seaports can lose their services if they do not eliminate these risks (Loh and Thai, 2015). Hence, port managers and supply chain partners were urged to mutually identify the possible supply chain risks and prepare an effective solutions. This collaborations will enable them to effectively deal with these undesirable events (Loh and Thai, 2015). This results shed light on the significant reason driving seaports to integrate more with supply chain partners. Besides, they argued that the shippers might call another seaport, if the selected ports fail to control the undesirable events. This collaborations; hence, can be considered as the value added activity of seaports. The cost of developing the proactive plan might be added to port tariff, if such the plan can truly secure the cargo of shippers. Apart from this value creativity, Leonie and Vis (2016) suggested the way for bulk ports to increase value to port customers. This can be attained by developing industrial clusters in the proximate hinterland at which seaports can benefit from the transshipment of product and logistics hub of industry in the industrial cluster. Seaports were encouraged to 1) extend their role, activities in facilitating cargo flow, 2) attract new flows of cargo, 3) execute value-adding activities, 4) develop industry cluster and 5) act as a knowledge center (Loh and Thai, 2015). The extension of seaports' and shipping companies' service to inland transportation and terminal will enable them to control the transportation chain, which is critical to their competitiveness in the near future Clott and Hartman (2016). The worthiness of collaborations with industrial partners locating in the hinterland was confirmed by the research finding of Song et al. (2016). They argued that if the cargo

volume from hinterland or transshipment increased at a certain level, it is likely for seaports to enjoy an increase of ports' handling prices. This indicates the possibility for seaport to develop the collaborative plan with hinterland partners. Furthermore, they also argued that the centralized management model will accomplish a higher supply chain profit than that of decentralized model. This corresponds to the strategic recommendation of Hoshino (2010) that the neighboring competitive ports should be organized by a single port authorities.

In conclusion, in accordance with a series of literature, seaports are proved as the strategic part of supply chain. Their services should be deployed and measured based on the logistics and supply chain perspectives rather than the fragmented activity basis. Ports' services, infrastructure, superstructure, strategy, communication procedures, information technology system and equipment and so on should be collaboratively determined by supply chain partners. This can be attained when the collaborative environment is built. The information sharing is agreed by all scholars as the critical factor for the success of port supply chain integration. The information technology as well trust among supply chain partners are fundamental for information sharing. Apart from these dominant factors, a bulk of factors affecting port integration were well documented in the work of Hudnurkar, Jakhar, and Rathod (2014).

2.2.3 Study in green shipping integration

The study on green operation and management in seaport can be explored in the previous study since the early 2000s, but indeed the green port has been discussed in the international arena since the late 1900s (Olson, 1994). Based on the review of literature, it is due to the fact that seaport is now seen as the strategic partner in supply chain which currently aims to balance the profitability of the supply chain participants and the environmental performance (Song and Panayides 2008; Yang, et al. 2013). Therefore, seaports need to adopt green practices to their operation and corporate goal. Moreover, because the shipping activities in port areas largely increased from the surge of international trade, the increasing of maritime traffic aggravates marine and air pollutions, which directly affect society. Seaports are mandatorily forced to implement green practices in their organizations. All kinds of port, especially large deep seaports, have been required by the International Maritime Organization (IMO) – one of the dominant organizations, who work as the supporter and regulator of seaborne trade – to deploy the environmental-friendly operation and management (IMO, 2011; Senarak, 2016). IMO member states are encouraged to adopt the regulations of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) to their national laws. For instance, port authority should provide the reasonable measures to ensure that the port reception facility (PRF) for receiving waste from cargo vessels is adequately provided in port areas in order to prevent marine pollution from ship-generated waste (IMO, 2000, 2011). Likewise, ship operators are required to install shipboard incinerators, which are designed and covered based on the standard of resolution MEPC.76 (40). The placards, garbage management plans and garbage record book are legally required onboard and ship masters or crews must be familiar with the management of garbage; otherwise, port state officers can investigate a foreign-flagged ship at a port or an offshore terminal of its State (IMO, 2011).

Corresponding with the discussion above, Lai et al. (2011) seems to be one of the first researchers who studied green management in shipping business. They

investigated 1) how shipping companies oriented green shipping practices (GSP) in their operation and 2) what factors driving them to implement GSP. The results show that the shipping firms will orient green shipping practices, such as *acquiring new green ship, cutting fuel consumption, optimizing ship speed, using alternative fuel, maximizing ship utilization, designing an eco-ship, building ship with recyclable material, encouraging shippers to use recyclable package, using environmentally friendly equipment onboard and on shore, using paperless shipping documentation and including green shipping practices in the firms' strategy* and so on, when 1) they are directly legally enforced by regulators, 2 their clients are considerably concerned with environmental performance, and 3) they desire to attain environmental goals (Lai et al., 2011). Despite the fact that the detail of GSP and the marine carriers' motivation to implement was heavily discussed, the GSP was analyzed based on only the shipping companies' perspective. Plambeck (2012) filled in this gap by including upstream and downstream supply chain participants in his analysis. He also pointed out, by what means, the firms can gain profits from the reduction of greenhouse gas (GHG) through the operation along the supply chain. His finding shows that, by using energy more efficiently and relying on renewable fuel, the businesses can enjoy cost reduction with their partners. Furthermore, the good public reputation from green orientation can be easily achieved, which can provide an opportunity for the firms to expand business in the community without public resistance. Therefore, if they would like to achieve these goals, the firms must work closely with their supply chain partners, both upstream supplier and downstream customer (Plambeck, 2012). On the one hand, the higher collaborations with customers, the higher possibility for the firms to better understand the process, need, expectation of the customers, and create products as well as services accordingly. On the other hand, the more collaborations with suppliers will provide the higher chance to mutually identify the weak point in operation as well as management, and then generate an appropriate solution through process redesign. In 2013, Hall et al. (2013) found that the collaborations including process redesign, information sharing, mutual learning and negotiation, etc., is the significant center of the initiation and implementation of green innovation in the shipping business. They argued that green innovation is the sub-category of innovation, which refers to *the new, modified process, procedure, system, policy, plan, financing, technology and equipment and so on, which are aimed to environmentally prevent and protect in maritime transportation-related activities*. For example, the liner shipping firms might introduce a new process in booking ship space or replace the paper-based documentary system by the paperless system, in order to reduce paper consumption. Seaports can supply the electricity generator onshore, in order that the berthing ships can use to energize their engine. This can reduce the use of bunkers in port areas, which reduces air pollution. However, the green innovation is the extension version of general innovation, which also needs the tight collaborations between shipping firms, seaports and shippers (Hall et al., 2013). Therefore, the information sharing, communication technology as well as the negotiation are critical to the success of innovation initiation.

Instead of focusing on the initiation and the implementation process of green innovation in the shipping business, Parola et al. (2014) investigated the characteristics of collaborations that seaports can use to gain access to the new market and green project. It was found that apart from 1) the contractual and equity co-operative agreements, 2 equity consortia, 3) alliances and mergers, 4) horizontal and vertical

partnerships and 5) other inter-firm co-operative ventures, the equity joint-ventures (EJVs) is the most popular collaborations that the international terminal operators use to enter new foreign markets and develop new green terminal projects (Parola et al., 2014). This knowledge was advanced by the finding of the work of Lam et al. (2013), who aimed to explore the strategy for the neighboring ports - Hong Kong and Shenzhen ports – to gain mutual benefits in pollution control as well as other economic profit, and eliminate major conflict from the proximity of port location. They argued that the international governmental office should be set up at the regional level so as to form regional maritime cluster. These two ports will mutually benefit from being shipping hugs, which attracts more cargoes to pass through their facilities. They can invest in the infrastructure for access to the hinterland, in order to facilitate the manufacturers' production (Lam et al., 2013). Despite the fact that a huge benefits were found from their research finding, its application is so broad that the shipping firms cannot bring the principle to implement in reality. As a result, Yang et al. (2013) filled in this gap by narrowing the scope and implication of the study from the regional level to the business level. They investigated the relationship among the internal green practices, the external green collaborations, the container shipping firms' environmental performance and the container shipping firms' competitiveness, and then suggested an appropriate business strategy. They found that the internal green practices and external green collaborations have a positive association meaning that the shipping companies must attain the internal green practices in an organization prior to developing external collaborations. If they fail to develop the internal integration across the organizational functions, they are more likely to fail the external green collaborations with partners (Yang et al. 2013). Furthermore, the external green collaborations and the ability to reduce the environmental impact (green performance) were explored as the mediator variables of the structural equation model (SEM) which indicated that the shipping firms can enjoy the competitiveness obtained from the internal green practices when they achieve the external green collaborations and environmental performance (Yang et al. 2013). This relationship guided the shipping firms to set up the strategy starting from the internal to the external green collaborations. However, in order to attain green collaborations, Lai et al. (2014) argued that the environmental information should be shared among the supply chain partners. The firms can gain benefits from environmental information sharing on the better understanding of the product, service and process requirement of their partners as well as cost reduction through energy saving and elimination of waste from process (Lai et al., 2014). On the one hand, this will enable the firms to make an effective plan, on the other hand, the suppliers also provide the suitable input (Lai et al., 2014). At the same time, Gibbs et al. (2014) inspected the role of seaport on the reduction of air pollution. They found that the air pollution was emitted from ship operation rather port operation. Therefore, the strategic measures reducing greenhouse gas (GHG) from the cargo ships should be placed on ship operators including 1) reducing vessel speed in order to reduce CO, NO, SO and PM emissions, and 2) encouraging green ship promotion. However, these measures need a huge support from the major related stakeholders, especially governmental agencies, for being the leader who initiates the campaign and, at the same time, being the regulator who controls the implementation of ship operators throughout the campaign (Gibbs et al., 2014). Nevertheless, this research concentrated on only air pollution prevention which is relatively narrow. Therefore, Lam and Notteboom (2014) advanced this knowledge by

analyzing the managerial tools oriented in of four leading seaports including Singapore, Shanghai, Antwerp and Rotterdam ports. The analysis revealed that seaports can control the pollution by orienting penalty price and incentive price through strategic pricing. This managerial tool has been heavily supported by the international campaign, such as Environmental Ship Index (ESI), etc. Furthermore, port authorities should monitor and measure their environmental performance. The Environmental Management System (EMS) should be clearly documented by terminal operators based on ISO 14001 so as to ensure that the terminal operators' operation and management are environmentally friendly to the air and marine environment (Lam and Notteboom, 2014).

At this stage, a series of previous literature indicated the importance of green shipping practices and its impact on the environmental performance as well as the competitiveness. Nevertheless, there is no study investigating on deciding how to implement green shipping practices. To fill in this academic gap, Lai and Lam (2015) developed the decision making model called "ANP-QFD model" for the shipping firms can use in reality. They found that the model was supportive for understanding the customers' environmental expectations, which enable the shipping firms to develop operational measures to attain the environmental outcomes (Lai and Lam, (2015). The significance of environmental issues in shipping business was then investigated by Davarzani et al. (2015), who reviewed a series of studies regarding marine pollution prevention, in order to indicate the focal trend of scholars. Apart from the reactive green approaches, the role of proactive green approaches will substantially increase in the future. The proactive approached comprises of the green shipping practices, such as optimal ship speed, routing optimization and alternative energy consumption, etc., which should be oriented in the organization of the shipping firms. Ship construction and technology are also on environmentally friendly basis, which will be measured by Energy Efficiency Design Index (EEDI) (Davarzani et al., 2015). Apart from onboard, the landside electricity will be encouraged to be supplied in seaports, in order to reduce the fuel consumption and GHG emission (Davarzani et al., 2015). In the similar year, Li et al. (2015) introduced the proactive approach by reusing empty containers. They argued that storing the empty containers at container yard will not only generate the GHG through the movement of empty containers by equipment, but also decrease the utilization rate of the yard. The latter case will prohibit seaports from increasing profitability. They suggested that green collaborations between seaports and other partners such as liner shipping firms, terminal operators and depot operators, etc., will benefits seaports by eliminating cargo volume imbalance between port of origin and port of destination. This collaborations will encourage partners to use empty containers, which allows them to make more profit from stuffing new cargo and, at the same time, the container yard of seaports will be used for storing export container other than empty containers (Li et al., 2015). It was also found that the ports that can reduce empty containers from their yard will be the first choice for the shipping companies to call. This finding not only pointed out the opportunity for seaport to set up new strategy, but also indicated the economic benefit gained from green collaborations (Li et al., 2015). Another proactive means to dealing with shipping pollution was presented in the work of Rodrigues et al. (2015), who investigated strategy to reduce CO emissions based on 5 scenarios with different alternative seaports in United Kingdom. The combination of transportation means was included in each scenario. It was found that the transportation via port of Southampton with a shift of container cargo from road to rail has the lowest

values for total freight transport cost and CO emissions (Rodrigues et al., 2015). The finding indicated that the green collaborations with other modes of transportation can also provide an impressive environmental performance and maintain the economic advantages.

In accordance with the existing knowledge from a series of literature since the late 1990s, the knowledge regarding supply chain, green supply chain, green shipping practices and green shipping collaborations as already documented. However, there are many rooms for future studies to improve. Firstly, the scholars' interest on supply chain management has dramatically increased, due to the rapid growth of business competition. Thereinafter, the original concept of supply chain management has been synchronized with green practices since the early 2000s. However, a bulk of studies was paid on the manufacturers' perspective, which leads to the imbalance of supply chain management knowledge between the product industry and service industry. This knowledgeable imbalance was recently relieved by some scholars, due to the fact that the rising of public awareness on the environmental impact from the operation of world fleet indicated the need of the study in shipping business. It was investigated by many studies that most leading container shipping companies and international terminal operators included green shipping practices in the firms' policy and planning. Strategies at the regional level and business level were recommended in many works. A few years ago, an increasing role of collaborations among the shipping firms throughout the supply chain shed light on the seaports and liner shipping companies, etc., were now seen as the strategic partners rather than normal transporter. Therefore, a number of studies paid attention on the investigation of green practices and competitiveness of the firms. The information sharing was agreed by a number of scholars as the central linkage of collaborative processes. However, the green operation and management are a broad concept, which need many cases to complete this knowledge. At this stage, the collaborations in the management of ship-generated garbage between seaports and the shipping firms cannot be explored from a series of literature. Therefore, an attempt on this study is considered worthy in terms of academicians' perspective as well as the practitioners' viewpoint. The summary of the previous literature and the contribution of this study adding to the existing literature are depicted in Figure 2.2.

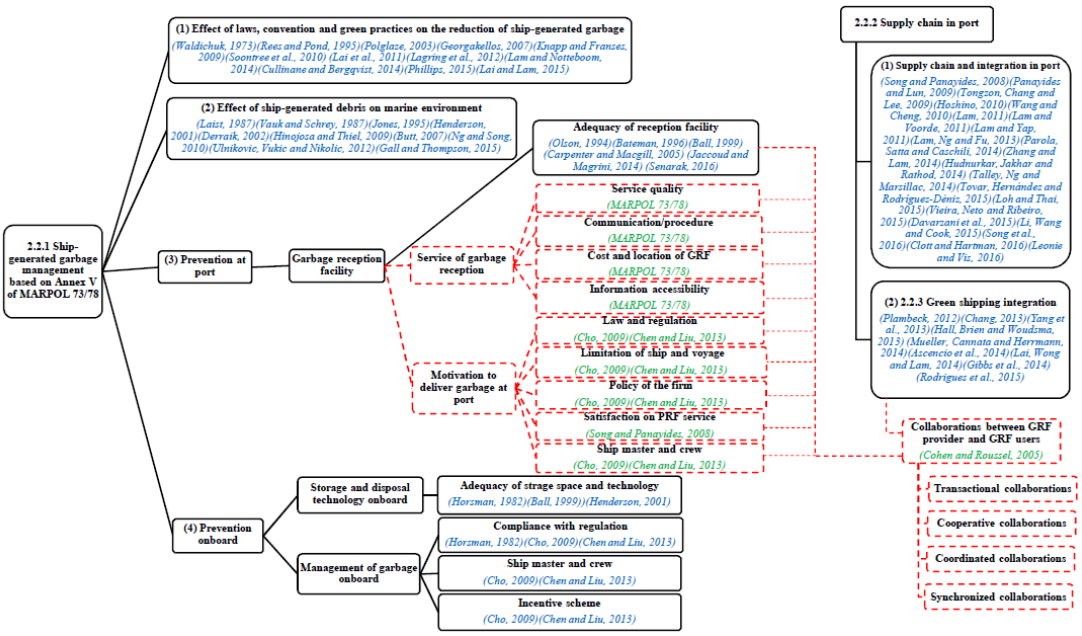

Figure 2.2 Theoretical focus and gap in the previous literature

In response to Figure 2.2, the related studies are classified into 3 main groups – 1) the study on ship-generated garbage management based on the regulations of MARPOL 73/78, 2) the study on port supply chain and integration, and 3) green shipping integration. The topics that were already studied are indicated by the solid line, while the topics that are the focal points of this study are shown in the dash line. It is noticed that a huge attempt was paid on the study in ship-generated garbage management based on Annex V of MARPOL 73/78 (as discussed in 2.2.1), especially in the effect of laws, convention and green practices on the reduction of ship-generated garbage (Group 1) and the effect of ship-generated debris on marine environment (Group 2), while a few studies in the Group 4 focused on the prevention of ship-generated garbage onboard. At the same time, many studies in the Group 3 concentrated on how to measure the physical adequacy of reception facility in port, which is not enough for seaport to prevent marine pollution ship-generated garbage, because the garbage reception facility (GRF) cannot be used to effectively prevent marine environment without the good provision of its service, such as the quality of GRF service, the efficiency of communication system between the provider and user, the ease of procedure to use GRF service, the reasonable charging system, the location of GRF and the accessibility to the GRF service information. This study argues that the adequacy of GRF as well as its service, as the supply side of GRF provision, are critical for seaports that need to convince the shipping companies to deliver their garbage. Apart from the supply side, the motivation to deliver garbage from ships operated by the shipping companies is also important for the success of the marine prevention, as the delivery of ship-generated garbage at the GRF depends on the decision making of the shipping firms. With this reason, the management of ship-generated garbage needs to be considered from both sides – seaports' and shipping firms' perspectives. However, this concept has never been studied by any scholars. To link the demand and supply sides, this study claims that seaports and shipping firms need to collaborate each other. Therefore, a review of literature regarding port supply chain and green collaborations

was conducted and discussed in 2.2.2 and 2.2.3 respectively. The concept of green shipping collaborations was drawn from the previous literature to adopt in ship-generated garbage management. The aim of this theoretical synchronization, as depicted by the red dash line, is to enhance the management of ship-generated garbage through shipping collaborations between seaports and shipping firms. This combination is supposed to lead to the exploration of new body of knowledge in green shipping collaborations that can effectively enhance the ship-generated garbage management.

2.3 Management of Ship-Generated Garbage in Thailand

This section aims to discuss about the management and the operation of ship-generated garbage in Thailand. Firstly, the related stakeholders such as the regulators, controllers and operators, are explained based on the documents of Marine Department of Thailand. Secondly, the environmental regulations and laws enforced by the related regulators are also briefly discussed. Finally, the operation of ship-generated garbage in Laem Chabang Port at which is the location of study is explained at the end of this section.

Thailand accessed the regulations of Annex I and II with the exception of Annex III, IV, V and VI of the convention (Australian Maritime Safety Authority, 2015). As a result, the regulations of Annex V have not been fully enforced on the shipping operation in Thai ports. Over the past few years; however, Thailand is preparing to gain access to the Annex V. Based on the study of Marine Department of Thailand, most of national regulations were relatively aligned with the regulations of Annex V of MARPOL 73/78 (Marine Department, 2008). In accordance with Annex V, flag state and port state control are required in be in charge of ensuring that all requirements of MARPOL 73/78 are implemented by shipping companies and terminal operators. The adequacy of reception facility and the un-compliance of the MARPOL 73/78 should be undertaken by them (IMO, 2011). Therefore, the following section will identify the organizations relating to the enforcement of MARPOL 73/78 in Thailand. The related organizations can be broadly classified into 2 groups – 1) governmental group and 2) private group (Marine Department, 2008).

2.3.1 Governmental group

The organizations in this group can be subdivided into 2 levels - 1) policy level and 2) operation level, respectively. At the policy level, the governmental agencies are in charge of supporting, monitoring and regulating the responsible sectors. The National Economic and Social Development Plan will be transformed to the development policy at the ministry and the department levels, which then will be transformed to the policy at the operation level, respectively. The organizations at the policy level enforcing the domestic laws regarding ship-generated garbage comprises of Ministry of Transport, Ministry of Natural Resources and Environment and Ministry of Industry.

2.3.1.1 Policy level

2.3.1.1.1 Ministry of Transport

Ministry of Transport is the major governmental agency of Thailand responsible for supporting the development of transportation infrastructure, superstructure and network throughout the country in the efficient and effective ways. The access to public transportation including land, rail, sea and air transportations of the citizens must be fairly organized and totally distributed. The construction projects of the transportation system are required to support the national development as a whole. Each mode of transportation must be linked and regulated by a particular agency. For marine transportation, the Marine Department of Thailand is the main organization, whose responsibility is supporting the development of carriage by sea, undertaking the linkage with other modes of transportation and ensuring the regulations of MARPOL convention are complied (Marine Department, 2008). The implementation of Marine Department is empowered by the regulations of the Navigation in Thai Waters Act B.E. 2456 (1913) and the Thai Vessel Act, B.E. 2481 (1938) (Marine Department, 2008).

2.3.1.1.2 Ministry of Industry

The responsibility of the Ministry of Industry is to promote and explore the ways to develop the industry including investment and other activities as specified by laws. The agencies under its administration are the Department of Industrial Works and Industrial Estate Authority of Thailand who is involving in formulating the policy regarding port waste management in Thailand (Marine Department, 2008). The Department of Industrial Works is in charge of monitoring and coordinating the industrial operation, controlling the hazardous substance and chemical so as to prevent marine pollution. Contrarily, the duty of the Industrial Registration Bureau is giving industrial permits for central operation of quality improvement, treatment or disposal of industrial and ship-generated waste. The domestics laws enforced by this department are such as the Factory Act, B.E. 2535 (1992) and the Hazardous Substance Act, B.E. 2535 (1992) (Marine Department, 2008).

2.3.1.1.3 Ministry of Natural Resources and Environment

One of the significant responsibility of the Ministry of Natural Resources and Environment is to reserve and conserve the forestry, national resources and environment in Thailand. The undertaking of sustainable utilization undertake of national resources and pollution prevention is also included in the ministry's mission, which is partially attained by 1) Pollution Control Department and 2) Office of Natural Resources and Environmental Policy and Plan. For the former case, this department is responsible for waste management in term of setting up the national pollution control policy, environmental quality standard, pollution control standard, environmental quality management plan and pollution monitoring. Likewise, the responsibility of Office of Natural Resources and Environmental Policy and Plan relates to that of Pollution Control Department (Marine Department, 2008). However, the former office

will concentrate on establishing the conservation policy, monitoring and evaluating the policy implementation and cooperating the foreign countries and international organizations in accordance with the regulation of Enhancement and Conservation of National Environmental Quality Act and the National Environment Promotion and Conservation Act, B.E. 2535 (1992) (Marine Department, 2008).

2.3.1.1.4 Ministry of Finance

The major responsibility of Ministry of Finance is determining the states' fiscal budget, collecting tax, managing public debts, arranging and developing state enterprises and government's assets, monitoring, and controlling the financial situation of the country. One of the major agency under its administration is Customs Department responsible for controlling import and export cargo in correspond to laws and regulations, collecting import and export tax, protecting custom tax avoidance and other illegal activities against the custom law. Ship-generated waste is due to the fact that some kinds of waste contains or contaminated with oil substances, which have an economic value. As a result, the transfer of ship-generated waste must follow the requirements and the procedures of Customs Department (Marine Department, 2008).

2.3.1.2 Operational level

In contrast to the policy level, those in the operational level are responsible for bringing policy to implement in the operation activity that is under their duty. Based on the document of Marine Department, the agencies related to ship-generated waste management in port areas are Port Authority of Thailand and Industrial Estate Authority of Thailand.

2.3.1.2.1 Port Authority of Thailand

Port Authority of Thailand (PAT) is an agency under the administration of Ministry of Transport. It is a state enterprise established and empowered under the regulations of Port Authority of Thailand Act, B.E. 2494 (1951) (Marine Department, 2008). The main responsibility of PAT is supporting the development of main ports in Thailand and managing and controlling the operation in port area in the ways that facilitate and satisfy the need of shippers and shipping lines. Ensuring the compliance of legal requirements in the operation of Bangkok Port (BKK) and Laem Chabang Port (LCP) is another vital duty of PAT, including the regulations of MARPOL 73/78. The operation and management regarding ship-generated garbage in BKK and LCP are relatively the same. For LCP, the operation begins with ship agents' submitting the notification form to the authority 24 hours prior to the ship's arrival. The amount and type of waste must be clearly declared in the form. Once cargo ships arrive at LCP, their waste will be operated in accordance with its characteristics. Generally, the victual waste and domestic waste will be directly transferred to the landfill of Laem Chabang Municipality for disposal, as it is not dangerous to marine and land environment. In contrast, the operational waste will be moved to the shed for sorting it into a particular type of waste. After that, it will be kept at the garbage

reception facility of LCP, in order to be transferred by the private contractor, as licensed and registered at Marine Department of Thailand, to the factory for treatment or disposal (Civil Engineering Division, 2015). The service cost for the use of reception facility service is normally included in port tariff. The charging rate varies depending on the types of ships, dwell time at port and location of berthing ship. In case of general cargo ships, container ships and coastal ships berthing at the quay, ship-generated waste will be transferred by truck and charged by 150 Baht/vessel/day while bulk carrier will be charged by 500 Baht/vessel/day. For mooring ships, ship-generated waste will be transferred by barge from mooring ship to the reception facility and charged by 2,000 Baht/vessel/day (LCP, 2013).

2.3.1.2.2 Industrial Estate Authority of Thailand

The Industrial Estate Authority of Thailand is under the administration of Ministry of Industry with the responsibility to develop and establish industrial estate by providing area for building up the industries and creating the managerial and operational policies for Map Ta Phut Port management.

2.3.1.2.3 Customs office in Laem Chabang Port

Apart from the responsibility in setting up the fiscal policy at the policy level, Customs Department established the office in Laem Chabang Port, in order to directly collect duty fee and other incomes, return of duty fee, control of vehicles and goods, inspect and release import or export goods through checking point, and violated goods from warehouse or tax free zone, sampling and test goods and proceed illegal custom case (Marine Department, 2008).

2.3.1.2.4 Local authority in Laem Chabang District

The local authority refers to Laem Chabang Municipality in charge of managing and preventing natural resource and environment in Laem Chabang District area, which covers the area of Laem Chabang Port. Only general garbage from ship such as domestic waste and victual waste, etc., is disposed at Landfill site of Leam Chabang Municipality while the hazardous waste will be arranged by private firm (Marine Department, 2008).

2.3.2 Private group

The private group mainly comprises of 4 private entrepreneurs involved in ship-generated garbage management and operation.

2.3.2.1 Treatment and disposal companies

The treatment and disposal of ship-generated waste are operated by private companies registered as the category 101 and 106 under the Factory Act, 1992 of Department of Industrial Works. On the one hand, the private companies in category 101 will be registered as the waste treatment operators, on the other hand, those in category 106 will be registered as waste recycle operators (Marine Department, 2008).

All private firms desiring to involve in ship-generated waste management in Laem Chabang Port must be qualified and listed by Marine Department of Thailand (Marine Department, 2008). At the present time, there are 37 private companies listed by Marine Department such as General Environmental Conservation (Public) Co. Ltd., Environmental Conservative Service Co., Ltd., BYL Environmental Service Co., Ltd., Waste Exchange Co., Ltd., Cita Thai Waste Management Service Co., Ltd., En-Technology Consultant CO., Ltd., and SC Management Co., Ltd. (Marine Department, 2008).

2.3.2.2 Terminal operators

Terminal operators refer to those given the right concession from Port Authority of Thailand (PAT) to provide and operate terminal service in Laem Chabang Port (LCP). Apart from facilitating ships in loading and discharging of cargo, terminal operators are required to monitor and control the generation of port waste and the delivery of ship-generated waste in terminal areas. For the former case, the storage equipment, such as the moderate-size bins, etc., is arranged at the convenient locations around the terminal. For the latter case, the responsibility of operation and management will belong to LCP. The LCP staff are responsible for providing the adequate reception facility for receiving ship-generated waste and operating it without undue delay to the routine operation of ships. Therefore, the terminal operators are directly related to the management of ship-generated waste, except facilitating the operation of LCP. Another related private firm is hazardous warehouse in LCP, which has been operated by JWD Info Logistics Co., Ltd. for 30 years (Marine Department, 2008). This firm is responsible for loading, discharging, and storing hazardous cargo and waste in its area. Besides, Unithai Shipyard and Engineering Co., Ltd. is another private firm related to ship-generated waste operation and management in LCP. This firm provide the tiny repair and maintenance to ship operators as the shipyard and dock operators. During repairing process, waste is normally aggravated and spilled into the sea water. Therefore, its operation and waste management is also monitored and controlled by LCP (Marine Department, 2008).

According to this information, the operation and management of ship-generated waste at LCP are depicted in Figure 2.3.

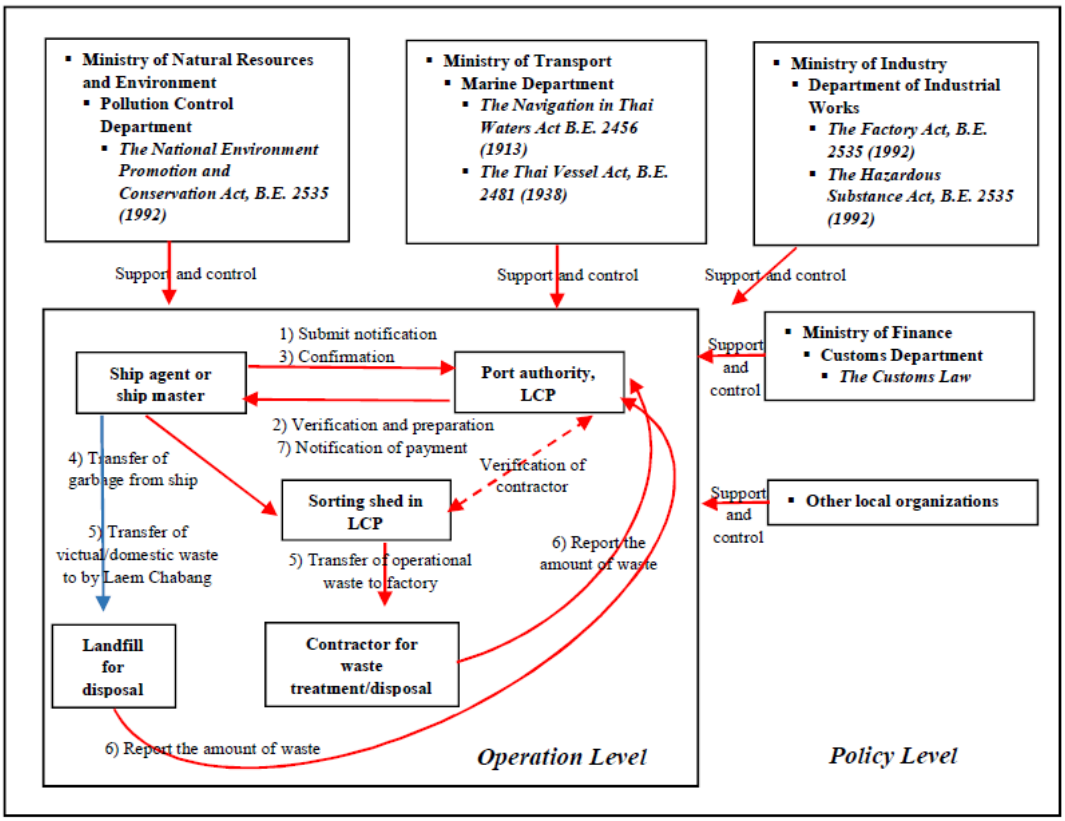

Figure 2.3 The operation of ship-generated garbage by related organizations

Corresponding with Figure 2.3, the Civil Engineering Division of LCP is directly in charge of all garbage-related operations, including GRF maintenance, process planning and statistic record, etc., whereas Port Authority of Thailand (PAT) is in charge of developing the environmental regulation and policy as well as the cooperation with the other institutes for technical assistance. Considering at the policy level, there are four main governmental organizations relating to the management of ship-generated garbage including 1) Pollution Control Department under the administration of Ministry of Natural Resources and Environment, 2) Marine Department under the administration of Ministry of Transport, 3) Department of Industrial Works under the administration of Ministry of Industry and 4) Customs Department under the administration of Ministry of Finance (Marine Department, 2008).

CHAPTER III
METHODOLOGY

The content in Chapter 3 aims to guide how this study is conducted. Basically, the research methodology was developed based on the theories, the direction of the previous literature and the existing operation and management of ship-generated garbage in Thailand, as discussed in Chapter 2. At the same time, the methodology is linked with the research objectives, research questions and research hypothesis, as mentioned in Chapter 1. Therefore, Chapter 3 are organized into 5 major topics and 1 conclusion section, as shown in Table 3.1.

Table 3.1 Structure of Chapter 3

<table>
<tr><th colspan="3">CHAPTER III</th></tr>
<tr><td rowspan="3">3.1 Research Process
3.1.1 Phase 1: research planning and preparation
3.1.2 Phase 2: proposal examination and data collection
3.1.3 Phase 3: analysis and presentation of result</td><td>3.2 Population and Sampling Technique</td><td rowspan="2">3.5 Development of Questionnaire
3.5.1 Questionnaire part 1
3.5.2 Questionnaire part 2
3.5.3 Questionnaire part 3
3.5.4 Questionnaire part 4</td></tr>
<tr><td>3.3 Data Collection</td></tr>
<tr><td>3.4 The Underlying Concepts and Method
3.4.1 Objective 1
3.4.2 Objective 2
3.4.3 Objective 3</td><td>3.6 Summary of Research Methodology</td></tr>
</table>

In accordance with Table 3.1, the process in conducting this research was firstly explained in 3.1 in order to guide how to accomplish the study sequentially. Afterwards, the population and sampling technique for selecting the right respondents was discussed in 3.2. Once the target groups were already determined, the approach for collecting data from the respondents were set up in 3.3. How to minimize response and non-response bias was also included in this section. Thereinafter, the content in 3.4 was aimed to illustrate how to analyze the data in order to obtain the research finding. The type of data, relationship of variables and statistics used for analyzing variables in each research objective were intensively explained. After the analytical process was planned, the questionnaire, as explained in 3.5, was then developed so as to gather the desired data through the survey. The content in 3.6 was created in order to demonstrate the overall linkage between the research methodology and the other research elements. The detail of each topic is discussed as the following.

3.1 Research Process

The process of this research is divided into 3 phases; phase 1 planning and preparation; phase 2 proposal examination and data collecting phase; phase 3 analysis and presentation of result. Each phase is discussed in detail as follows:

3.1.1 Phase 1: research planning and preparation

This is the first stage of the study that aims to plan and set up the direction of the research. The overall processes in phase 1 are outlined in Figure 3.1.

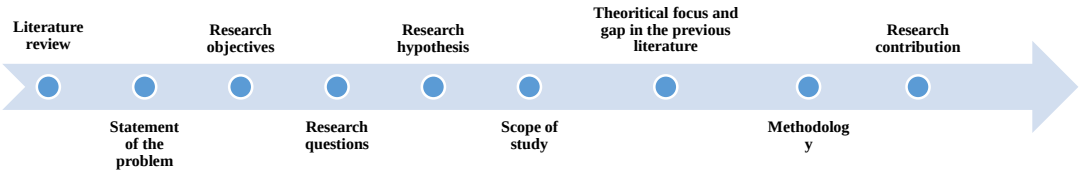

Figure 3.1 The research processes in phase 1

Corresponding with the flow of process in Figure 3.1; initially, the previous literature since the early 1970s was intensively reviewed, in order to identify what the scholars had already done over the past decades. A number of studies and theories are explained and discussed in Chapter 2. Afterwards, the academic gap found in the literature review was linked to the existing problem regarding the marine pollution from ship-generated garbage and its management in the container port. The motivation to conduct this study is described in statement of the problem. Once the research background was discussed, the research objectives were determined and linked with the research questions and the research hypothesis respectively. In order to control the variables that will be included in an analysis, the scope of the study was set up. After that the theoretical focus and gap in the previous literature was created in order to sharpen the contribution of this study to the existing literature. Once the beginning concept of the study was clear, the research methodology such as research method, data collection, etc., was determined. The research tool used for gathering data from the shipping firms that are the target of the study is the questionnaire. The related parameters explored from the previous literature were transformed into form of the statement and well organized into a particular topic in the questionnaire. Finally, the research contribution to the existing literature and to the work of the practitioner was explained.

3.1.2 Phase 2: proposal examination and data collection

Once the research plan was completed and the questionnaire was ready for survey, next step is to collect the required data from the shipping firms. The processes in phase 2 are depicted in Figure 3.2.

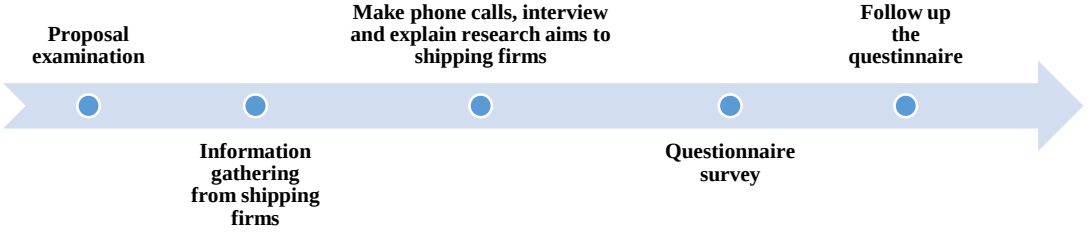

Figure 3.2 The research processes in phase 2

In accordance with the flow chart in Figure 3.2, the research proposal has to be investigated and approved by the committees in the proposal examination. Once the proposal is approved, the data collection begins with gathering the information regarding the name of the shipping companies that visit Laem Chabang Port (LCP). This information was obtained from the database of Port Authority of Thailand. The contact addresses and telephone numbers of the shipping firms were mainly accessible through the Google search engine but some of the information was given by colleagues. Afterwards, the telephone calls were used to contact the companies and search for suitable representatives. The respondent will be shortly interviewed by the author, in order to investigate their qualification supposed to be the person, who is in charge of garbage-related operation on shore or onboard, and has an experience in contacting the authority of LCP. Once the target person was found, the research background will be briefly explained, in order to minimize the response-bias as well as non-response bias. Thereinafter, the questionnaire will be submitted to the respondent immediately after the telephone call via either email or Google online form depending on the convenience of the respondents. Ultimately, in case the respondents do not return the questionnaire in time, they will be followed up by a telephone call. The follow up process is supposed to be not greater than 3 times after the first submission and not longer than 6 months.

3.1.3 Phase 3: analysis and presentation of result

After the needed data is gathered entirely from the respondents, the processes in phase 3 are performed. Each process is demonstrated in Figure 3.3, while the detail of the statistical methods used for analysis per research objective is discussed in 3.4.

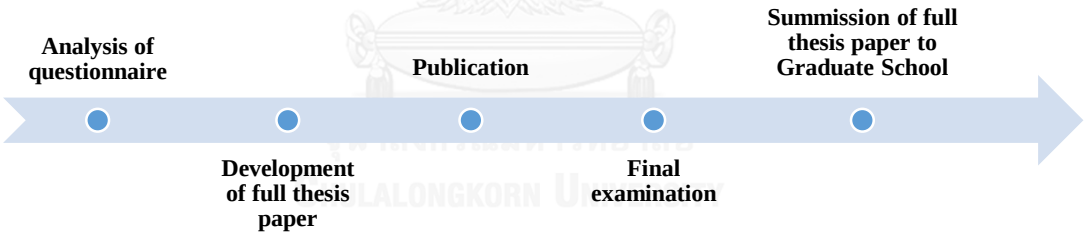

Figure 3.3 The research processes in phase 3

Corresponding with Figure 3.3, once the questionnaires were gathered from the shipping firms, they will be analyzed by different statistics methods depending on research objectives. Afterwards, the full thesis paper will be developed in accordance with the requirement of the Graduate School, Chulalongkorn University. At the same time, the research paper will be developed based on the finding of the study and published in the journals approved by Graduate School, Chulalongkorn University. After that, the completed thesis paper will be investigated and approved by the committees involved in the final examination before uploading it into the thesis-online system of the Graduate School, Chulalongkorn University, for the final approval.

3.2 Population and Sampling Technique

The population of the study is the shipping companies and agents, who utilize the garbage reception facility (GRF) of Laem Chabang Port (LCP). According to the database of the Port Authority of Thailand (PAT), there are around 300 ship operators berthing and using the facilities of LCP (Civil Engineering Division, 2015). However, once the non-GRF user such as barge operators, offshore supply vessel operators, etc., and the redundant names of the operators are excluded from the list, 148 operators, including the operators of container ship, general cargo vessel, Ro-Ro vessel and bulk carrier remain (Civil Engineering Division, 2015). In order to obtain the information as completely as possible, the study uses the purposive sampling technique to specifically pick up one respondent per company. All respondents are required to be in charge of garbage-related operation on shore or onboard. Alternatively, they must have an experience in contacting the authority of LCP. Those who do not qualify will not be allowed to fill in the questionnaire.

3.3 Data Collection

The required data for developing questionnaire is gathered from literature reviews and the interviews of the staff from Marine Department of Thailand and Port Authority of Thailand, while the needed data for analysis is collected from the questionnaire survey. For the latter case, it aims to gather the data from the shipping firms based on the research objectives 1 - 4 as presented in 1.2.1-1.2.4. The questionnaire will be developed and submitted to the shipping firms via two channels – email and online channels. The name of the shipping companies and agents was obtained from the database of Port Authority of Thailand. The contact address and telephone number are mainly accessible through the Google search engine but some of the information is given by colleagues. Afterwards, telephone calls are used to contact the companies and search for the suitable representative. The respondents are specifically selected based on their responsibility and experience regarding ship-generated garbage operation and management, and then are asked to indicate the degree to which they agreed or disagreed to the statements by using the Likert-scales ranging from 1 (strongly disagree) to 5 (strongly agree).

3.4 The Underlying Concepts and Methods

3.4.1 Objective 1

3.4.1.1 The underlying parameters

Corresponding with research objective 1, the aim is to investigate the existing service performance of the garbage reception facility (GRF) of Laem Chabang Port (LCP). Therefore, the related parameters have to reflect the performance of the GRF service of LCP. Basically, as its vital role on marine pollution prevention, the 8th regulation of Annex V in MARPOL convention concentrates on by what means GRF should be performed by port authority and related stakeholders. The parameters such as 1) the sufficiency of GRF, 2) the reasonable cost of GRF service, 3) the accessibility to GRF information, 4) the ease of contacting procedure and 5) the location of GRF

service center were mainly extracted from MARPOL convention (IMO, 2000, 2011). However, Song and Panayides (2008) argued that the service quality should be ensured if seaports demand to satisfy their clients (Song and Panayides, 2008). The quality of GRF service was included as the primary parameter. At the end of developing stage, the parameters and the statements in the questionnaire were investigated by two academicians, who have an expertise in maritime transportation and econometrics and two practitioners working in Civil Engineering Division in LCP, in order to ensure the content validation. A minor revision in content and layout of the questionnaire was made in accordance with the recommendation. Thereinafter, three respondents, who are in charge of managing ship-generated garbage of the shipping companies, were asked to conduct a pilot test of the first draft of the questionnaire. The finding shown that they understood the statements well except a few items that they cannot fill in. Again, a minor modification was performed and the questionnaire was reinvestigated by two practitioners in order to maintain its validity. Finally, once the statements of the questionnaire were verified, as presented in Table 3.2-Table 3.7, it then was distributed to the respondents.

All in all, parameters were organized into 6 groups that measure different dimensions of performance of the GRF service provision including 1) the adequacy of the GRF, 2) the quality of the GRF service, 3) the ease of communication and procedure to use GRF service, 4) the cost of GRF service, 5) the comfort perceived from the location of GRF service provision center, and 6) the accessibility to the GRF service information. Each group has a different number of statements relying on the detail of such the topic. The evaluation scale for each statement is based on the direction in the work of Lai et al. (2014) who used the Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree).

3.4.1.1.1 Independent variable

3.4.1.1.1.1 Transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year)

As mentioned in Chapter 2, collaborations refers *to by what means the companies in supply chain work together towards mutual objective through the sharing of ideas, information, knowledge, risks and rewards* (Cohen and Roussel, 2005). Theoretically, there are many levels of collaborations relying on the intense and the depth of relationship between the partners. The transactional collaboration is the basic type of collaborations, which is normally applied to the routine tasks that appear frequently or the day-to-day activities that are not complicated, such as material purchasing, repair and maintenance and document submission between customer and supplier, etc. As a result, the partners that have this relationship rarely need an expensive information technology for data sharing. The comfort of the transaction is the focal point an improvement rather than formulating a solid strategy with partners. Therefore, the loose and short-term association is normally found among the companies orienting the transactional collaborations.

Seaports encounter the intensive transactional collaborations. Due to the competitive environment in the world business, seaports are no longer seen as the interface between sea and land transportation, but as the strategic

partner in the supply chain (Song and Panayides, 2008). Thus, seaport needs to collaborate with the other companies in supply chain such as the sea carrier etc. in order to accomplish the goal of the entire chain rather than the port itself. During the year, the container port, especially the leading port, has to facilitate more than millions of trips of vessels. Annually, it is implied that there are a million times of discharge of garbage in port. Corresponding with the statistics of PAT and the collaborations theory of Cohen and Roussel (2005), the ship operators that annually visit LCP can be broadly classified into 3 groups based on the justification of one maritime specialist as well as two administrators in PAT; namely, 1) Low group; 2) Moderate group; and 3) High group. The Low group refers to the shipping companies that contact the authority of LCP less than 60 times per year. This group shows the lowest transactional collaborations. Shipping firms contacting the authority of LCP between 61-240 times per annum are classified into the Moderate group. This group indicates the moderate transaction collaborations. Finally, the highest transactional collaborations belongs to the High group which comprises of those who contact the authority of LCP more than 240 times per year. The levels of transactional collaborations are hypothesized that there is an effect on the reasons to use GRF of ship operators.

3.4.1.1.1.2 Nationality of the shipping firms

The nationality of the shipping firms implies the differences of organizational environmental policies. The foreign shipping firms, especially the leading container lines, are assumed that they will emphasize the environment prevention and responsibility rather than Thai shipping companies. This postulate is based on the fact that the enforcement of environmental laws and regulations and legal penalty forced on the wrong doer in Thailand is not as strong as those in the developed countries. Furthermore, the foreign shipping firms normally sail ships for shippers around world. This drives them to ensure the environmental standard of their fleet. Contrarily, the environmental issue seems to be relatively insignificant for local shipping firms as their fleet sailing between local ports. In accordance with this postulate, the nationality of the shipping firms is considered having an effect on the difference of the motivations to deliver garbage at port and the need to collaborate with port and so on. In an analysis, this explanatory variable is divided into 2 groups – 1) Thai shipping firms and 2) branches of foreign shipping firms in Thailand.

3.4.1.1.1.3 Types of ships

Types of cargo ship are claimed by this study as the critical factor playing on the different of the perceptions on the existing performance of garbage reception facility (GRF) service, as discussed in research objective 1. This is because different types of ships are served by different means. For instance, the container ship normally berths at the quay front of terminal at which its ship-generated garbage is transferred by truck. Contrarily, the large ship such as bulk carrier, etc., normally prefers berthing at the mooring point at which its garbage will be moved by barge. Hence, the shipping firms operating different types of ship might have dissimilar perception on the GRF service. Likewise, the motivations affecting the use of GRF

service, as discussed in research objective 2, of different-ship operators can varies for many reasons. Based on the same example, different locations of berthing ships will be charged for the GRF service by different rates. The gap of GRF service cost might affect their motivation differently. Moreover, the nature of container ship will be used for carrying containerized cargo, whereas a general cargo ship is designed for carrying the unpackaged cargo. The operational waste as well as cargo residual generated from the general cargo ship seem to be much greater than those produced from the container vessels. The scarcity of storage space onboard indicates the greater need for general cargo ships to remove their garbage than other types of ships and so on. Therefore, types of ships are determined as the independent variable. According to the database of Port Authority of Thailand, there are only 4 types of ships - container ships, general cargo ships, Ro-Ro vessels and bulk carriers - delivering their ship-generated garbage at the GRF in Laem Chabang Port (LCP), whereas the other types of vessels discharge their operational waste at the private GRF provided by terminal operators. Thus, this explanatory variable is classified into 5 groups – 1) the shipping firms operating only container ships, 2) the shipping firms operating only general cargo ships, 3) the shipping firms operating only Ro-Ro vessels, 4) the shipping firms operating only bulk carriers, and 5) the shipping firms operating more than 2 types of ships.

3.4.1.1.2 Dependent variable

The dependent variables in the 1th objective are aimed to reflect the performance of the provision of GRF service for receiving ship-generated garbage at Laem Chabang Port. The performance is measured in 6 dimensions mainly based on the literature review and the regulations in the Annex V of MARPOL convention. The underlying concept of each variable is discussed below.

3.4.1.1.2.1 Adequacy of the GRF (R1A1-R1A4)

The adequacy of GRF basically refers to the capability of garbage reception facilities to receive ship-generated garbage from cargo vessels, in terms of volume and types of garbage. The more ability of seaports to receive all kinds of garbage in any volume means the more adequacy of GRF based on the definition in the regulation of MARPOL convention. Maintaining the adequacy of GRF can be considered as the proactive approach of seaports aiming at preventing marine pollution from sea transportation. Therefore, the questionnaire statements from R1A1 to R1R4 are developed to reflect the adequacy of GRF provided by Laem Chabang Port including 1) its ability to receive ship-generated garbage, in term of volume as well as type (R1A1- R1A2) and 2) its availability to serve cargo ships, once they arrive the facility of seaports (R1A3), and 3) its responsible operators (R1A4). '

3.4.1.1.2.2 Quality of the GRF service (R1B1-R1B3)

Apart from the adequacy of GRF, shipping firms- as the GRF users - need to be served by seaports with good services, in order to gain

competitiveness. This means that the quality of port services, including GRF service, are important from the customers' point of view. Therefore, this variable aims to measure the quality performance of GRF service provided by Laem Chabang Port which reflects from the occurrence of delay in providing GRF service (R1B1), the ports' ability to attain the service commitment, which is measured by deal date/ time and location (R1B2), and environmental quality, which is evaluated from ports' ability to prevent marine pollution (R1B3).

3.4.1.1.2.3 Ease of communication (R1C1-R1C3)

Another important factor encouraging the shipping companies to discharge ship-generated garbage at GRF is the ease of communication and procedure. Seaports are urged by the International Maritime Organization through the regulation of MARPOL 73/78 to simplify the communication system and procedure in transferring garbage from ships to the GRF so as to facilitate ship operators' operation. The difficulty in contacting port authority and the complexity of procedure for the use of GRF service can discourage the shipping firms to use GRF of seaports. Therefore, the statements under this variable aim to measure the ease of notification submission process (R1C2), the complication of procedure (R1C1), and the attempt in simplifying process through information technology (R1C3).

3.4.1.1.2.4 Cost of GRF service (R1D1-R1D5)

Service cost is another significant indicator that reflect the performance of GRF service provision of Laem Chabang Port (LCP). If LCP can manage GRF efficiently, the cost of GRF operation and management can be reasonably set up, and the service charge of GRF service might be deducted from the port tariff. Furthermore, the International Maritime Organization also emphasize all ports to determine the reasonable cost of GRF service in order not to discourage the liner shipping firms to deliver ship-generated garbage at such the port. With this reason, cost of service should be considered as the considerable factor reflecting the performance of GRF service of seaports. Therefore, the statements R1D1 to R1D5 in the questionnaire aim to measure the reasonableness of GRF service cost (R1D1-R1D3). The degree of agreement and disagreement on the current charging system that 1) includes GRF service cost in the port tariff (R1D4) and 2) mandatorily forces all ship operators to pay (R1D5) is also included in the questionnaire.

3.4.1.1.2.5 Location of GRF service center (R1E1-R1E3)

Despite of the fact that most of the communication system depends on electronic charnels such as the Internet based communication system and Electronic Data Interchange (EDI) and so on, the operation in the provision of GRF service of Laem Chabang Port (LCP) is still based on manual practices, such as the submission of notification form for the use of GRF, etc. Thus, the location of the service center in LCP plays a vital role on the ease of contact. The location of service center can facilitate the shipping firms in accomplishing the documentary transaction.

The difficulty in finding the service center might discourage the firms to deliver their ship-generated garbage at ports, as it wastes cost and time of the shipping firms. As a result, a list of statements aims to measure the performance of the GRF service in terms of the ease in finding the service center (R1E1) and the location of service center on their operation performance (R1E2-R1E3).

3.4.1.1.2.6 Accessibility to the GRF service information (R1F1-R1F3)

Before the shipping firms can use the GRF service of Laem Chabang Port (LCP), they have to know about this service in terms of how to contact LCP staff, the cost of GRF service and how to submit the notification form to port authority and so on. This indicates the importance of information supplied by LCP. LCP should provide the information regarding the GRF service through accessible channels such as the ports' website, etc. Another effective channel is the port authority's staff, who can inform the GRF-related information to the ship agents. The lack of information can generate the negative effect on the decision making of the shipping firms in delivering ship-generated garbage at ports. Therefore, the statements R1F1 to R1F3 aim to measure the accessibility of the shipping companies to the information regarding GRF service of LCP in term of 1) the ease to access to the information (R1F1), 2) the decision making process based on the sufficiency of information (R1F2), and 3) the recognition of information channel of the shipping firms (R1F3).

3.4.1.2 Method

As mentioned in Chapter 1, the first objective (RO1) is divided into 2 assumptions; namely, RQ1-A: what is the current performance of the provision of garbage reception facility (GRF) provided in the study port? and RQ1-B: is the performance of GRF service perceived differently among the groups of the shipping firms? To answer the first question (RQ1-A), the process begins with finding the parameters reflecting the performance of GRF service provision from the previous literature. Afterwards, the existing performance will be evaluated by the shipping firms through the questionnaire survey. Descriptive statistics was used to analyze average, minimum and maximum of the score, in order to find the overall performance of the GRF service. Contrarily, in order to explore the answer of the second research question (RQ1-B), the multivariate analysis of variance (MANOVA) was used to analyze the statistical difference of the current performance of the GRF service of LCP perceived by the shipping forms. The relationship between variables in MANOVA is illustrated in Figure 3.4.

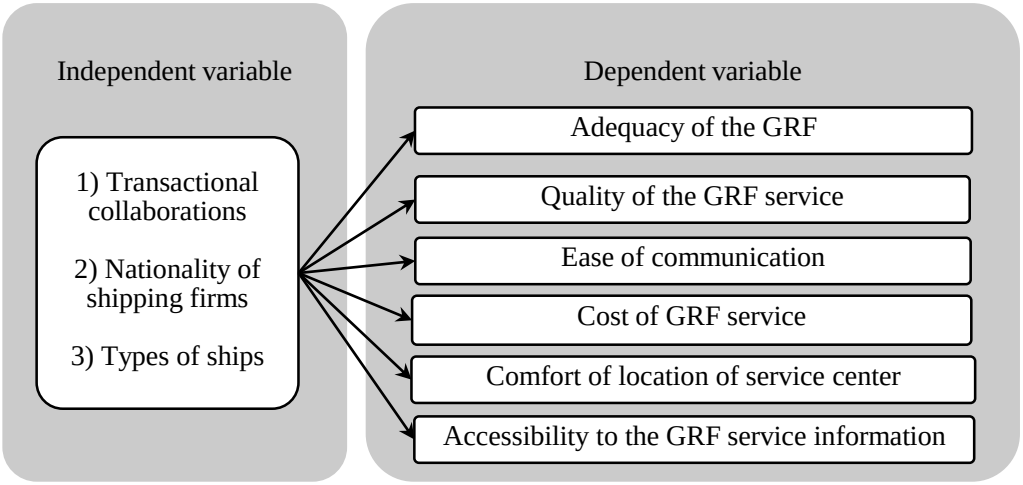

Figure 3.4 The relationship of variables in MANOVA of objective 1

According to Figure 3.4, the transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year), the nationality of the shipping firms and the types of ships are the independent variables, while the dependent variables are comprised of 1) adequacy of the GRF, 2) quality of the GRF service, 3) ease of communication and procedure to use GRF service, 4) cost of GRF service, 5) comfort of the location of GRF service provision center and 6) accessibility to the GRF service information. The MANOVA was used to investigate whether the level of transactional collaborations, nationality of shipping firms and types of ship have an effect on the difference of the perception on the existing performance of the GRF service provided by LCP or not. The analysis was proceeded in IBM SPSS Statistics 21.

3.4.2 Objective 2

3.4.2.1 The underlying parameters

As discussed in Chapter 1, the second objective is to analyze the factors that affect the motivation of the shipping companies to deliver their ship-generated garbage to the GRF of Laem Chabang Port (LCP). Therefore, the focal point of this objective is the word "motivation" that affects the decision making of the shipping firms to deliver ship-generated garbage at the reception facility at LCP. Basically, a set of parameters was mainly extracted from the work of Cho (2009) and Chen and Liu (2013) who focused the parameters that dominate the delivery of garbage at port by the fisherman in fishery industry of Korea. Furthermore, the content validity was ensured by intensive literature review from the related works such as Jones (1995), Bateman (1996), Ball (1999), Carpenter and Macgill (2005), Cohen and Roussel (2005), Song and Panayides (2008), Knapp and Franses (2009), Cho (2009), Ng and Song (2010), Chen and Liu (2013) and Lam and Notteboom (2014) and so on. This is to make the questionnaire covering all related contents. Once the parameters were extracted from the related literature, the statements that will be used to ask the respondents were then developed. The list of statements used to elicit the reasons why the shipping companies

use the GRF of Laem Chabang Port (LCP) was arranged under 5 topics: 1) law and regulation; 2) navigation limitation; 3) cooperation; 4) competitiveness; and 5) environmental consciousness. The number of the statements varies depending on the details of each topic. The clarity of the meaning and the content were validated by two academicians, who have an expertise in maritime transportation and econometrics, and two practitioners, who have a long experience in garbage management onboard and in port. A minor revision in content and layout of the questionnaire was made in accordance with the recommendation. Thereinafter, three respondents who are in charge of managing ship-generated garbage of the shipping companies were asked to conduct a pilot test of the first draft of the questionnaire. The finding shows that they understood the statements well except a few items that they cannot fill in. Again, a minor modification was performed and the questionnaire was reinvestigated by two practitioners, in order to maintain its validity. Finally, once the statements of the questionnaire were verified, as presented in Table 3.8-Table 3.12, it then was distributed to the respondents.

3.4.2.1.1 Independent variables

The independent variables are 1) the transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year), 2) the nationality of shipping firms and 3) the types of ships, which are already mentioned in 3.4.1.1.1.

3.4.2.1.2 Dependent variables

The dependent variable refers to the motivations of the shipping companies to use garbage reception facility (GRF) of Laem Chabang Port (LCP). To obtain this variable, the practice of GRF management in LCP was intensively reviewed from the document of Port Authority of Thailand, Marine Department and the interview of LCP staffs. Besides, the parameters; namely, law, regulation (Knapp and Franses, 2009; Ng and Song, 2010), navigation limitation (Jones, 1995; Ball, 1999; Carpenter and Macgill, 2005), cooperation (Cohen and Roussel, 2005), competitiveness (Bateman, 1996; Song and Panayides, 2008; Lam and Notteboom, 2014), and environmental consciousness (Cho, 2009; Chen and Liu, 2013), were extracted from the previous literature and then modified for using in this study.

3.4.2.1.2.1 Law and regulation

All environment-related activities in maritime transportation are controlled by the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) and its extension rules (Knapp and Franses, 2009; Ng and Song, 2010). No matter what issues, such as ship design, cargo operation onboard, handling equipment, qualification of ship masters and crews, types of bunkers and garbage treatment and disposal on board, etc., are all regulated by the international conventions. Shipping companies; therefore, are likely to discharge garbage at GRF of LCP, due to the enforcement of MARPOL and SOLAS etc. (R2A1). Moreover, because the environmental laws in most countries have penalty and normally align with the regulations of MARPOL convention, it is possible for ship operators to be in comply

with the national laws by using GRF (R2A2). Port regulations are another factor that drives ship operators to use GRF because it explains what ship operators are obliged to be in comply with as well as what ship operators are prohibited to perform during operating in port. As a result, Port Authority of Thailand and Marine Department seem to dominate the delivery of garbage at GRF of LCP as they control the marine traffic in LCP in terms of safety and environment (R2A3, R2A4). The statements (R2A1- R2A4) evaluating the effect of law and regulation were listed in Table 3.8.

3.4.2.1.2.2 Navigation limitation

The limitation of navigation is an important reason for ship operators to discharge garbage at GRF. In practice, there is the limited storage space onboard the ship for keeping garbage that is produced during the trip (R2B2) (Jones, 1995). If the storage space is full, it will aggravate problems to the ship operation (Ball, 1999). Therefore, the ship master tends to discharge garbage at the GRF of every visited port, including LCP (R2B1, R2B6). The scarcity of GRF in the previous port (R2B5) is another potential reason forcing ship master to deliver garbage at the GRF of LCP, because the garbage is not removed prior to the departure of ship at the previous port which results in the fullness of storage space. Likewise, the lack of GRF in the next port of discharge can generate a similar challenge to ships (R2B3) (Carpenter and Macgill, 2005). This is the reason why all ports have been urged to provide an adequate GRF. Apart of its deficiency, the unreasonable cost of GRF service is another potential reason that dominates ship operators' decision making process (R2B4). If GRF service is charged with the disincentive price, ship operators tend to be reluctant to use it. The attributions (R2B1- R2B6) that assess the effect of navigation limitation on the use of GRF were listed in Table 3.9.

3.4.2.1.2.3 Cooperation

The provision of GRF and garbage collecting service in port relies on the cooperation between internal and external partners of an organization, as experienced in the other activities of all kinds of business (Cohen and Roussel, 2005). Practically, port authority has to cooperate with ship operators regularly (external partner), covering from the transactional operation such as the daily contact for the use of GRF and the submission of document to the authority etc. to the strategic cooperation such as the long-term contract in improving garbage treatment and disposal (R2C2) and so on. For the former case, the transactional task is a routine work that is simple and not vital to the shipping company (R2C1). Thus, the decision making generally depends on a few persons, such as ship masters or ship agents (internal partner) (R2C4). Contrarily, the judgment in the latter case is essential to most ship operators, because it is a vital task relating to the huge investment aiming at cost and time reduction (R2C3). The final decision; thus, normally requires a brainstorm of the executives from the inside to the outside of the organization rather than an individual judgment. To assess its impact on the use of GRF, different ways of cooperation were listed in statement R2C1 to R2C4 in Table 3.10.

3.4.2.1.2.4 Competitiveness

The operation of seaports, including GRF provision, needs to create the competitive advantage, as described in the statement R2D1 to R2D4 of Table 3.11, to the entire chain in term of velocity, cost and quality, etc. (Song and Panayides, 2008). The velocity of port service (R2D2) is very vital for sea carriers, because the shippers need to sell products before their rivals do (Song and Panayides, 2008). To respond to this requirement, the GRF of ports should be provided as fast as possible in order not to aggravate any delay to the ships. Similarly, the price of GRF service (R2D4) should be reasonably set up, in order to generate cost competitive advantage to the shipping lines and the shippers (Bateman, 1996; Lam and Notteboom, 2014). The quality of GRF provision is also considerable to the shipping lines. It was explored that ports having a better environmental performance are more favored by sea carriers (Lam and Notteboom, 2014). Therefore, the higher ability to receive garbage from ships indicates the higher capability to prevent marine pollution (R2D1), which will satisfy the shipping companies that orient green management and strategy. Besides, the ease of GRF-service provision (R2D3) can attract ship operators to use port facilities as it reduces the complexity of the shipping firms' operation.

3.4.2.1.2.5 Environmental consciousness

The perspective of the ship operators on marine environment substantially dominates the motivation to use GRF (Cho, 2009; Chen and Liu, 2013). It was found that the educated ship masters and crews will demonstrate self-discipline (R2E3) to protect the sea environment as well as aquatic creatures from the negative externality generated from ship operation (R2E1). Furthermore, they tend to be enthusiastic in comply with the MARPOL regulations such as bringing ship-generated garbage back to dispose at port (R2E6) with the willingness to pay for this extra cost (R2E4) rather than throwing this duty to the governments' responsibility (R2E2). Since they generally know what will occur to marine environment and society (R2E5), if the related stakeholders fail to complete the required regulations, most of shipping companies will encourage all ports of call to provide an adequate GRF (R2E7). To evaluate the environmental consciousness on the motivation to use GRF; hence, the attributions (R2E1 to R2E7) were developed and shown in Table 3.12.

3.4.2.2 Method

As mentioned in chapter 1, the second objective (RO2) is divided into 2 questions; namely, RQ2-A: what are the factors that affect the motivation of the shipping firms to deliver their garbage at the GRF of the study port? and RQ2-B: are motivations different among the groups of the shipping firms? To answer the former question (RQ2-A), the related factors were gathered from the literature review, as mentioned in 3.4.2.1. After the data was obtained from the questionnaire survey, descriptive statistics was used to analyze average, minimum and maximum of the score, in order to find the overall degree of the motivation of the shipping firms to deliver ship-generated garbage at the reception facility of LCP. Contrarily, to find the answer to the second question (RQ2-B), the multivariate analysis of variance (MANOVA) was

used to analyze the statistical difference of motivation among the shipping firm based on 1) the level of transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year), 2) the nationality of shipping firms and 3) the types of ships operated by the shipping firms. The relationship between independent and dependent variables in MANOVA is illustrated in Figure 3.5.

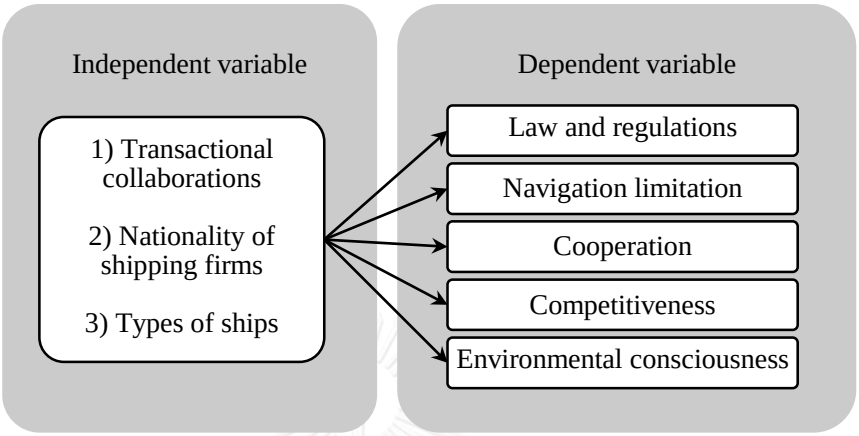

Figure 3.5 The relationship of variables in MANOVA of objective 2

Corresponding with Figure 3.5, the transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year), the nationality of the shipping firms and the types of ships are the independent variables while the dependent variable includes law and regulations, navigation limitation, cooperation, competitiveness and environmental consciousness. The MANOVA was used to investigate whether the level of transactional collaborations, the nationality of the shipping firm and the type of ship have an effect on the difference of motivation of the shipping companies to deliver ship-generated garbage at the reception facility of Laem Chabang Port or not. The analysis was proceeded in IBM SPSS Statistics 21.

3.4.3 Objective 3

3.4.3.1 The underlying parameters

3.4.3.1.1 Independent variables and dependent variables

The research objective 3 aims to investigate the relationship between paired levels of green shipping collaborations in ship-generated garbage management between Laem Chabang port and its clients. The detail of each variable is explained as follows.

3.4.3.1.1.1 Transactional collaborations

The transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year) used in the multinomial logistic regression analysis will differ from that used in the analysis of other research objectives. Previously, the number of ship calls per annum was adopted to represent the levels of

transaction. In objective 3; however, the statements (R3A1-R3A7) reflecting the transactional collaborations in ship-generated garbage management are developed based on the operational information obtained from Laem Chabang Port (Civil Engineering Division, 2015). In accordance with the operation, the transaction occurs when the shipping firms need to deliver ship-generated garbage at GRF (R3A1). The transactional information are compulsorily demanded by LCP (pull system) (R3A6), and submitted by hand (R3A2 and R3A5). In this relationship, the individual attempt in improving the ease of communication process (A2) and system (A6) so as to increase the efficiency of GRF service (R3A3) and reduce transactional cost (R3A4) as well as time (R3A7) is another essential aspect. However, the communication in transactional collaborations is on one-sided basis rather than two-way communication, which is found in the higher level of collaborations.

3.4.3.1.1.2 Cooperative collaborations

The cooperative collaboration is an extended form of transactional collaborations with a higher level of information sharing between the partners (Cohen and Roussel, 2005). The push and pull systems in sharing information (R3B4, R3B6) through an electronic channel, such as the Internet and Electronic Data Interchange (EDI), etc., are preferable to manual practice (R3B7). The ease of documentary process is normally improved by mutual efforts between partners. This improvement includes the standardization and redesign of document (R3B1). Therefore, the statements R3B1- to R3B8 were aimed to measure this characteristics of cooperative collaboration and its benefits on the firms' performance, which was inferred from the previous literature. The positive effect from this collaboration might appear in the form of cost and time reduction (R3B2), development of management plan (R3B3), efficiency increase (R3B5), decrease in delay (R3B8).

3.4.3.1.1.3 Coordinated collaborations

The outstanding characteristics of coordinated collaborations in the management of ship-generated garbage is the dependence on partners' capabilities. The efficiency and the advancement of communication technology system as well as garbage reception facility (GRF) of Laem Chabang Port (LCP) heavily affect the shipping firms' performance, in terms of time and cost reduction (R3C4). Thus, in the coordinated environment, LCP tends to assist its customers through the improvement of communication technology and the responsiveness to the need of the shipping firms (R3C1). The partners' problems seems to be immediately solved (R3C6). Furthermore, the shipping companies are likely to synchronize their garbage management plan with those of LCP (R3C3) so as to eliminate the conflict from the misalignment of their plan. Moreover, an attempt in trying to understand the managerial and operational process of its partners (R3C2) should be explored in the coordinated relationship. In addition, the coordinated collaborations largely relies on the negotiation and consultation (R3C5), because it allows them to increase the linkage of plans and the understanding of operation process. The two-way communication system normally requires an intensive investment in the sophisticated information technology, which needs to be carefully considered by two

partners. The critical data together with knowledge should be obtained from the mutual development of research project and course training by an experts (R3C7-R3C8).

3.4.3.1.1.4 Synchronized collaborations

The dominant feature of synchronized collaborations is the participation of all related stakeholders in the high value added activities that are worthy enough to be invested by all partners. Therefore, the synchronized relationship normally focuses on a long term benefits rather than the short term profits. Based on this aspect, if there is the existence of the synchronized relationship in the ship-generated garbage management, the long term relationship should be discovered through the activities that are critical to the overall performance of supply chain such as the development of the common database among supply chain participants (R3D4) and the mutual use of technology in the provision of garbage reception facility at port (R3D2). All plans and policies regarding how to deal with ship-generated garbage as well as how to maintain the adequate provision of GRF and so on should be linked or agreed by all related stakeholders (R3D1). The decision should be made based on the overall interest of supply chain participants rather than the interest of individual firm (R3D6). The benefits can reflect from the increase of efficiency (R3D3), the enhancement of the planning and forecasting accuracy (R3D5), increase of competitiveness (R3D7), and environmental performance of the firms (R3D8). The relationship between variables was conceptualized in Figure 3.6.

3.4.3.2 Method

As mentioned in 3.4.3.1, the research objective 3 aims to investigate the association between pairs of green shipping collaborations comprising of 1) transactional and cooperative collaborations, 2) transactional and coordinated collaborations, 3) transactional and synchronized collaborations, 4) cooperative and coordinated collaborations, 5) cooperative and synchronized collaborations, and 6) coordinated and synchronized collaborations, respectively. The ordinal score of the statements reflecting transactional collaborations (R3A1-R3A7), cooperative collaborations (R3B1-R3B8), coordinated collaborations (R3C1-R3C8) and synchronized collaborations (R3D1-R3D8), as shown in Table 3.13 - Table 3.16, will be analyzed based on the 6 models below by using ordinal regression, which is the is an extension of the general linear model to ordinal categorical data. The relationship of variables in is outlined in Figure 3.6.

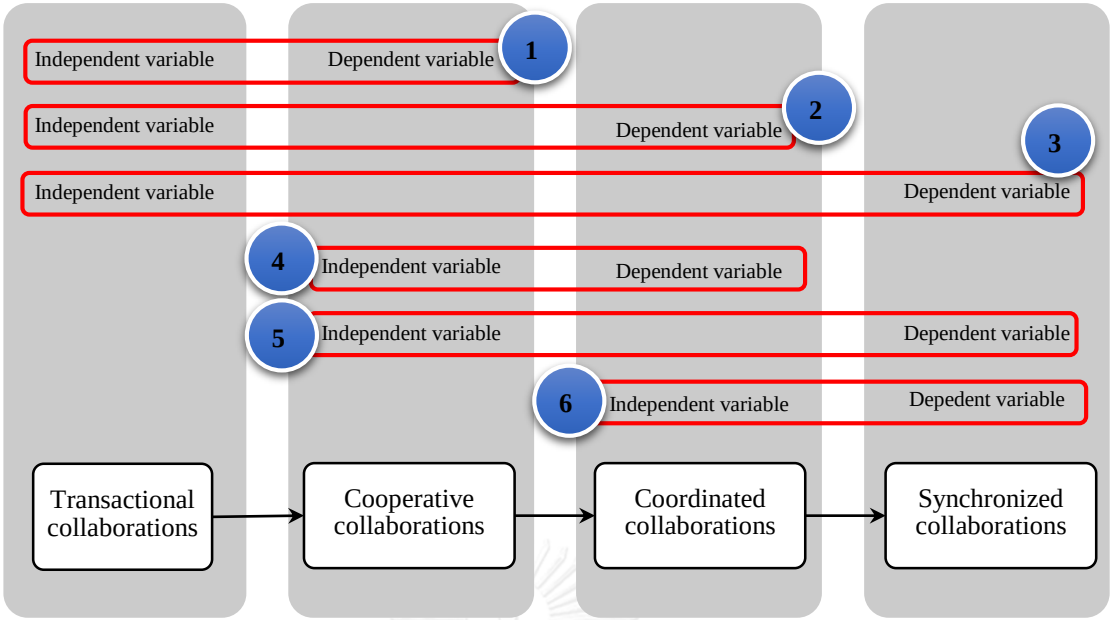

Figure 3.6 The relationship of variables in ordinal regression

Corresponding with Figure 3.6, the chart describes the relationship between pairs of variables in each model. All in all, there are 6 ordinal regression models. Each ordinal regression model, both independent variable and dependent variable will be treated as ordinal scale variable with 5 orders (1 strongly disagree to 5 strongly agree). Therefore, the event of each rating score can be defined in form of odd ratio, based on the accumulated probability of ordering events, as the following.

θ_1 = prob(score of 1) / prob(score greater than 1)
θ_2 = prob(score of 1 or 2) / prob(score greater than 2)
θ_3 = prob(score of 1 or 2 or 3) / prob(score greater than 3)
θ_4 = prob(score of 1 or 2 or 3 or 4) / prob(score greater than 4)

The last category (score 5) doesn't have an odds associated with it since the probability of scoring up to and including the last score is 1.

The 1st model of OLR aims to investigate the impact of transactional collaborations (R3A1-R3A7) on the probability to develop the cooperative collaborations (R3B1-R3B8). The ordinal logistic model can be formulated as equation 1 (E1).

$$\ln(\theta_{ji}) = \alpha_{ji} - \beta_k X_k \qquad \text{(E1)}$$

where j goes from 1 to the number of categories minus 1.
i represents dependent variable R3B1-R3B8.
k represents independent variable R3A1-R3A7.

The 2nd model aims to inspect the effect of transactional collaborations (R3A1-R3A7) on the probability to develop the coordinated collaborations (R3C1-

R3C8). The relationship between the variables in model 2 can be mathematically demonstrated in equation in form of ordinal logistic model (E2).

$$\ln(\theta_{ji}) = \alpha_{ji} - \beta_k X_k \qquad \text{(E2)}$$

where j goes from 1 to the number of categories minus 1.
i represents dependent variable R3C1-R3C8.
k represents independent variable R3A1-R3A7.

The 3rd model aims to inspect the effect of transactional collaborations (R3A1-R3A7) on the probability to develop the synchronized collaborations (R3D1-R3D8). The relationship between the variables in model 3 can be mathematically expressed in form of ordinal logistic model (E3).

$$\ln(\theta_{ji}) = \alpha_{ji} - \beta_k X_k \qquad \text{(E3)}$$

where j goes from 1 to the number of categories minus 1.
i represents dependent variable R3D1-R3D8.
k represents independent variable R3A1-R3A7.

The 4th model aims to inspect the effect of the cooperative collaborations (R3B1-R3B8) on the probability to develop the coordinated collaborations (R3C1-R3C8). The relationship between the variables in model 4 can be mathematically expressed in form of ordinal logistic model (E4).

$$\ln(\theta_{ji}) = \alpha_{ji} - \beta_k X_k \qquad \text{(E4)}$$

where j goes from 1 to the number of categories minus 1.
i represents dependent variable R3C1-R3C8.
k represents independent variable R3B1-R3B8.

The 5th model aims to inspect the effect of the cooperative collaborations (R3B1-R3B8) on the probability to develop synchronized collaborations (R3D1-R3D8). The relationship between the variables in model 5 can be mathematically expressed in form of ordinal logistic model (E5).

$$\ln(\theta_{ji}) = \alpha_{ji} - \beta_k X_k \qquad \text{(E5)}$$

where j goes from 1 to the number of categories minus 1.
i represents dependent variable R3D1-R3D8.
k represents independent variable R3B1-R3B8.

The 6th model aims to inspect the effect of the coordinated collaborations (R3C1-R3C8) on the probability to develop synchronized collaborations (R3D1-R3D8). The relationship between the variables in model 6 can be mathematically expressed in form of ordinal logistic model (E6).

$$\ln(\theta_{ji}) = \alpha_{ji} - \beta_k X_k \qquad \text{(E6)}$$

where j goes from 1 to the number of categories minus 1.
i represents dependent variable R3D1-R3D8.
k represents independent variable R3C1-R3C8.

Corresponding with ordinal logistic model (E1) - (E6), ordinal regression will be used to analyze the impact of the variables in the lower level of collaborations on the possibility for the shipping firms to develop the higher level of collaborations with Laem Chabang Port in ship-generated garbage operations and management. The finding obtained from testing Hypothesis 3-A for each ordinal logistic model can be used to answer the Research Question 3-A, which is expected to provide the direction for future improvement or development of green shipping collaborations between these parties. The ordinal regression was proceeded in IBM SPSS Statistics 21. Basically, the parameter estimates (coefficients) are the logit (log odds ratio) of such the variable, while the statistical significance of coefficients ($p<.05$) means that such the significant variable has an effect on the dependent variable. The positive coefficient (+) of significant variable indicates the increase of odds ratio (OR) when the value of independent variable is changed from the base group to such the significant variable, while the negative coefficient (-) demonstrates the opposite meaning. This should be taken in account when interpreting the result of ordinal regression.

3.4.4 Objective 4

In response to the research objective 4, it aims to analyze the benefits of the green shipping collaborations (GSC) between Laem Chabang Port and the shipping firms in the context of ship-generated garbage management. To accomplish this objective, it begins with finding the answer of Research Question 4-A - what are the benefits of collaborations between the port and the shipping firms in the context of ship-generated garbage management in the container port? The answer of this question can be initially explored from the previous literature including the work of Lai et al. (2011), Plambeck (2012), Hall et al. (2013), Parola et al. (2014), Lam et al. (2013), Yang et al. (2013) and Gibbs et al. (2014) as their finding indicated the benefits that can be adopted as the benefits of GSC, such as the firms' performance and competitiveness, the supply chain performance and the environmental performance. Thereinafter, the statements reflecting the benefits of GSC was developed. The clarity of the meaning and the content were validated by two academicians who have an expertise in maritime transportation and econometrics, and two practitioners, who have a long experience in garbage management onboard the ship and in port. A minor revision in content and layout of the questionnaire was made in accordance with the recommendation. Thereinafter, three respondents, who are in charge of managing ship-generated garbage of the shipping companies, were asked to conduct a pilot test of the first draft of the questionnaire. The finding shows that they understood the statements well except a few items that they cannot fill in. Again, a minor modification was performed and the questionnaire was reinvestigated by two practitioners, in order to maintain its validity. Therefore, the final statements are presented in Table 3.13- Table 3.16.

3.4.4.1 The underlying parameters

3.4.4.1.1 Independent variable

There are three independent variables including the level of transactional collaboration, the nationality of the shipping firm and the type of ship which are already mentioned in 3.4.1.1.1.

3.4.4.1.2 Dependent variable

3.4.4.1.2.1 Benefits of transactional collaborations

Benefits of the transactional collaborations means the positive effect generated from collaborations between Laem Chabang Port and the shipping firms at the transactional level. The potential parameters are extracted from the work of of Lai et al. (2011), Plambeck (2012), Hall et al. (2013), Parola et al. (2014), Lam et al. (2013), Yang et al. (2013) and Gibbs et al. (2014) and modified for using in ship-generated garbage management based on the theory of (Cohen and Roussel, 2005). The ease of transaction seems to be the focal incentive of transactional collaborations. According to the previous literature, partners having transational collaborations normally enjoy improving the communication process (R3A3) as well as contacting system (R3A7), in order to increase the efficiency to investing in mega projects, which heavily need trust between partners and high expected return. Moreover, reducing cost (R3A4) is another benefit gained from transactional relationship. Most transactional partners tend to eliminate or reduce the transactional cost, in order to benefit themselves and their partners.

3.4.4.1.2.2 Benefits of cooperative collaborations

Similar to the case of transactional collaborations, the benefits of cooperative collaborations refer to the positive effects generated from collaborations between Laem Chabang Port and the shipping firms at the cooperative level. The potential parameters are extracted from the work of of Lai et al. (2011), Plambeck (2012), Hall et al. (2013), Parola et al. (2014), Lam et al. (2013), Yang et al. (2013) and Gibbs et al. (2014) and modified for using in ship-generated garbage management based on the theory of (Cohen and Roussel, 2005). Corresponding with the literature, documentary standardization between partners is the basic task to attain as it can reduce the operational cost and time (R3B2). Another vital aspect of cooperative collaborations is sharing more information with partners, in order to enhance the accuracy of plan (R3B3). The Advance submission of document or notification form can assist their partners to prepare a good plan (R3B5), which can result in reducing waste and decreasing delay (R3B8).

3.4.4.1.2.3 Benefits of coordinated collaborations

Benefits of the coordinated collaborations means the positive impact created from collaborations between Laem Chabang Port and the

shipping firms at the coordinated level. Similarly, the potential parameters are extracted from the work of of Lai et al. (2011), Plambeck (2012), Hall et al. (2013), Parola et al. (2014), Lam et al. (2013), Yang et al. (2013) and Gibbs et al. (2014) and modified for using in ship-generated garbage management based on the theory of (Cohen and Roussel, 2005). The alignment of plan between partners is the important task in the coordinated environment. The partners will take an effort in understanding the plan, policy and other related strategy of their partners, in order to better generate the aligned plan. The mutual attempt in improving service, product and process is also found in this collaborations (R3C4). To attain this, the continuous negotiation and consultation with partners is the key success factor of coordinated collaboration, which can lead to the mutual development of new body of knowledge (R3C8). By doing so, it can increase the performance as well as the competitiveness of the firms.

3.4.4.1.2.4 Benefits of synchronized collaborations

The synchronized collaboration is the highest level of collaborations between partners, which is the primary base of the success of supply chain management. It requires the participation of all related partners in making decision of the considerable issues and determining the strategy. Their plans must be synchronized, which result in increase the efficiency (R3D3). Using the same information and relying on the common database are critical benefits of synchronized relationship, which can increase the accuracy of plan and forecast (R3D5). The lack of synchronized collaborations can obstruct the partners in increasing capability and performance of the firms (R3D7). Furthermore, apart from the firms' performance, it was proved that the synchronized situation can increase the environmental performance (R3D8), which can increase the competitiveness of the firms Yang et al. (2013). Therefore, this collaborative level normally addresses with the strategic task needing the complicated decision making process.

3.4.4.2 Method

Once the questionnaire is evaluated by the shipping firms, the descriptive statistics will be used to find the average score, minimum score and the maximum score, which can be adopted to answer the Research Question 4-A. The statistics will indicate the overall benefits gained from the green shipping collaborations between Laem Chabang Port and the shipping firms.

After that, the parameters discussed above will be further analyzed by using the multivariate analysis of variance (MANOVA), in order to find that whether the benefits of GSC are different among the shipping forms or not. This finding is the answer of Research Question 4-B, which can be discovered from the test of the Research Hypothesis 4-B - *H_0: the benefits of collaborations with port are not different among the groups of shipping firms*, and *H_1: the benefits of collaborations with port are different among the groups of shipping firms*. The acceptance of the null hypothesis means that the shipping firms have the common benefits from green collaborations. Contrarily, the rejection of null hypothesis indicates that there is difference in gaining benefit from green collaborations among the shipping firms. The relationship of variables in MANOVA is in Figure 3.7.

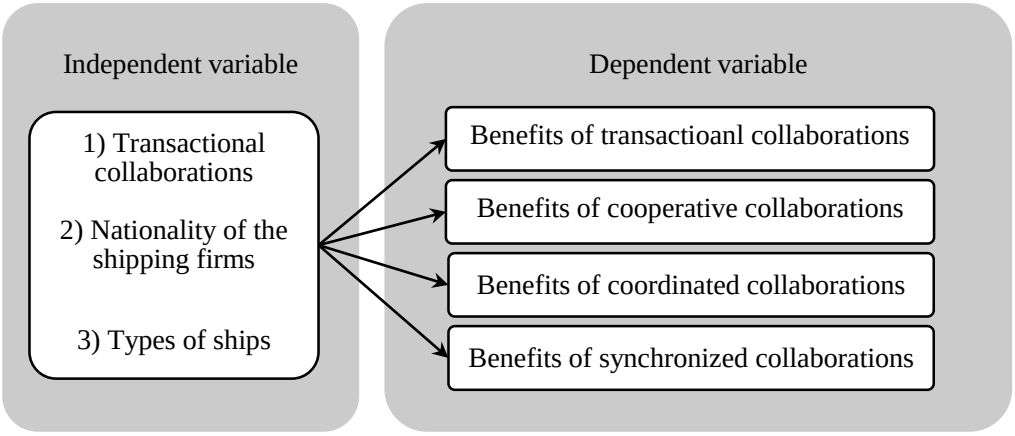

Figure 3.7 The relationship of variables in three-way MANOVA of objective 4

In response to Figure 3.7, the chart indicates the relationship between the transactional collaboration (high, moderate and low frequency of ships berthing at LCP per year), the nationality of the shipping firms and the types of ships (independent variables) and the benefits gained from the transactional, cooperative, coordinated and synchronized collaborations (dependent variables). The multivariate analysis of variance is applied to investigate the impact of three independent variables on the difference of the benefits gained from different levels of collaborations. The analysis was proceeded in IBM SPSS Statistics 21.

3.5 Development of Questionnaire

The analysis of the study relies on both the primary data and the secondary data depending on the research objectives. The conceptualization of this study is initially based on the secondary data which was gathered from the previous literature, the database of Port Authority of Thailand, and the document of Marine Department of Thailand etc. Contrarily, the primary data, which is required by research objective 1, 2, 3 and 4, is gathered from the shipping companies that annually visited Laem Chabang Port through the questionnaire survey. Overall, the questionnaire is divided into 4 major parts for obtaining the data required by research objectives. The alignment between different parts of the questionnaire and the research objectives is depicted in Figure 3.8, while the full questionnaire (Thai language) is presented in Appendix E.

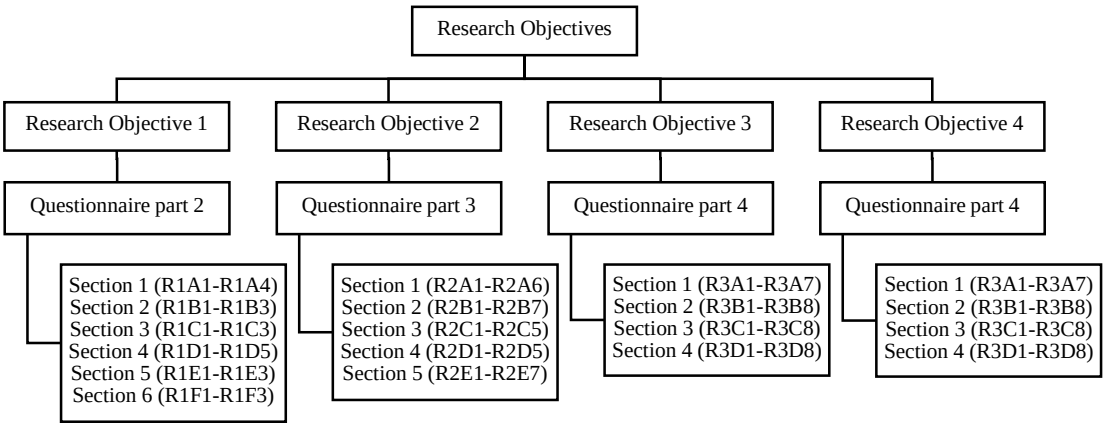

Figure 3.8 The alignment of research objectives and questionnaire

In accordance with Figure 3.8, the questionnaire part 2, 3 and 4 are particularly designed for obtaining the data required for the analysis in the research objective 1, 2, 3 and 4 respectively while the questionnaire part 1 is excluded from the figure as it is developed for gathering the general information from the representative of the shipping firms, such as company names and general practices of the firms. The questionnaire part 2 contains 6 sections. Each section is comprised of different statements coded in capital letters and digits such as R1A1, etc. The questionnaire part 3 contains 5 sections. Each section is comprised of different statements coded in the similar system as adopted in the questionnaire part 2. The questionnaire part 4 contains 4 sections. Each section is comprised of different statements coded in the common system as used in questionnaire part 2 and 3. The details of each part of the questionnaire are discussed as the following.

3.5.1 Questionnaire part 1

Part 1 of the questionnaire aims to gather the general data; namely, the name of the firm and the detail of the implementation in delivery process of ship-generated garbage. Totally, there are 12 questions demanding the respondents to answer. The questions are described in Thai language with the details as follows:

Q1: Please state your company's name in the blank……..…….

The question Q1 aims to gather the names of the shipping companies while the other information regarding the firm, such as the frequency in using Laem Chabang Port, the type/size of ship operated by the firms, the previous port of discharge and the next port of discharge and so on, is already known from the database of Port Authority of Thailand.

Q2: How do you submit the notification form to Laem Chabang Port for the use of waste reception facility?

- ☐ Manual (in person)
- ☐ Telephone call
- ☐ Electronic document (by email)

Otherwise…….

The aim of the question Q2 is to investigate how ship operators submit the notification form to Laem Chabang Port for the use of waste reception facility. There are three check boxes for 1) manual (in person), 2) telephone call and 3) electronic document (by email), and one blank space for the respondent to answer that is not included in the questionnaire.

Q3: How do you know about the garbage reception service of Laem Chabang Port?

- ☐ Ship agent
- ☐ Port officer
- ☐ Terminal operator
- ☐ Website of Laem Chabang Port
- ☐ Port instruction and document

Other (please specify)…….

The question Q3 aims to explore how ship operators know about the garbage reception service of Laem Chabang Port (LCP), which indicates the potential channel for port authority to provide the information regarding the garbage reception facility. According to the interview of two officers in LCP, there are five possible channels that provide the information for the shipping firms; namely, 1) ship agents, 2) port officers, 3) terminal operators, 4) Laem Chabang Port website and 5) port instructions and documents. These channels are included in the questionnaire, whereas the blank space is also provided for the respondents to answer other channels that is not included in the questionnaire.

Q4: How often do you use garbage reception facility when your ship arrive?

- ☐ Always
- ☐ 90-99% of arriving ships
- ☐ 80-89% of arriving ships
- ☐ 70-79% of arriving ships
- ☐ 50-69% of arriving ships
- ☐ 30-49% of arriving ships
- ☐ 10-29% of arriving ships
- ☐ 1-9% of arriving ships
- ☐ Never

Other (please specify)…….

The question Q4 aims to investigate the frequency that the ship operators deliver their ship-generated garbage to the garbage reception facility (GRF) of Laem Chabang Port (LCP). The question reflects the frequency through the ratio between the number of times that ship operators deliver their ship-generated garbage at the GRF of LCP and the total number of times that ship operators visit to LCP. There are nine check boxes to choose ranging from 100% to 0%, while the blank space is also provided for the respondents to answer other ranges of frequency not included in the questionnaire.

Q5: Who is the person that make a decision to discharge garbage at Laem Chabang Port?

- ☐ Ship master
- ☐ Ship manager
- ☐ Ship agent
- ☐ Executive officer

Other (please specify)…….

An objective of the question Q5 is to find the person, who plays an important role on the decision making to deliver ship-generated garbage at the garbage reception facility of Laem Chabang Port (LCP). There are four possible persons, based on the interview of two officers working at the Civil Engineering Division of LCP and two officers working at the shipping companies, playing on this process including 1) ship master, 2) ship manager, 3) ship agent and 4) executive officer. However, the blank space is also provided for the respondents to answer other persons not included in the questionnaire.

Q6: Please indicate the estimated amount of ship-generated that you deliver at the garbage reception facility of Laem Chabang Port.

- ☐ Victual waste…….kilograms/year
- ☐ Domestic waste…….kilograms/year
- ☐ Operational waste…….kilograms/year

The question Q6 aims to measure the proportion of different types of ship-generated garbage that shipping firms deliver to the garbage reception facility of Laem Chabang Port. There are three blank spaces provided for the respondent to indicate the amount of three types of ship-generated garbage – victual waste, domestic waste and operational waste - that is delivered per year.

Q7: Please rank the following statements demonstrating the causes that affect the performance of the garbage reception service of Laem Chabang Port. The number ranks from 1 (the highest effect) to 8 (the lowest effect).

- ☐ Adequacy of garbage reception facility.
- ☐ Efficiency of garbage receiving process.
- ☐ Ease of service procedure.
- ☐ Location of garbage reception facility.
- ☐ Cost of garbage reception service.
- ☐ Ease of information accessibility.
- ☐ Convenience of contacting process.

Other (please specify)…….

The question Q7 aims to initially investigate the factors that affect the performance of the garbage reception service from the shipping firms' perspective. Based on the literature review, there are seven possible factors are included in the questionnaire including adequacy of garbage reception facility, efficiency of garbage receiving process, ease of service procedure, location of garbage reception facility, cost of garbage reception service, ease of information accessibility and convenience of

contacting process. Nevertheless, the blank space is also provided for the respondents to answer the other factor that is not included in the questionnaire.

Q8: Please rank the following statements indicating the causes that affect your motivation to deliver ship-generated garbage at the garbage reception facility of Laem Chabang Port. The number ranks from 1 (the most important cause) to (8 the least important cause).

- ☐ Enforcement of law and regulation
- ☐ Disappearance of delay of ship
- ☐ Limitation of storage space onboard
- ☐ Reasonable cost of service
- ☐ Company policy

Otherwise…….

The question Q8 aims to investigate the causes that affect the motivation of the shipping firms in delivering their ship-generated garbage at the garbage reception facility of Laem Chabang Port. The potential causes are reviewed from the work of Cho (2009), Chen and Liu (2013) and Lam and Notteboom (2014); namely, enforcement of law and regulation, disappearance of delay of ship, limitation of storage space onboard, reasonable cost of service and company policy. Likewise the other question, the blank space is also provided for the respondents to answer the other encouraging cause that is not included in the questionnaire.

Q9: Please rank the following statements indicating the causes that discourage you to deliver ship-generated garbage at the garbage reception facility of Laem Chabang Port. The number ranks from 1 (the most important cause) to 6 (the least important cause).

- ☐ Loose enforcement of law and regulation
- ☐ Appearance of delay of ship
- ☐ Abundance of storage space onboard
- ☐ Excessive cost of service
- ☐ Other better choices of garbage reception service

Otherwise…….

This question aims to explore the causes that discourage the shipping firms to deliver their ship-generated garbage at the garbage reception facility (GRF) of Laem Chabang Port (LCP). The potential causes are composed in the ways that indicate the opposite meaning to the causes listed in the question Q8; namely, loose enforcement of law and regulation, appearance of delay of ship, abundance of storage space onboard, excessive cost of service and other better choices of garbage reception service. Likewise, the blank space is also provided for the respondents to answer the other discouraging cause that is not included in the questionnaire.

Q10: Are you interested in developing or improving the garbage reception facility and its' service with Laem Chabang Port?

- ☐ Interest
- ☐ No interest

An objective of the question Q10 is to explore whether the shipping firms have an interest in developing or improving the garbage reception facility and its service with Laem Chabang Port or not. It is the binary answer – interest or no interest.

Q11: If your answer in Q10 is "interest", please indicate the aspects of collaborations that you are interested in.

- ☐ To improve the notification form used in the operation of garbage reception facility.
- ☐ To improve the communication procedure in the operation of garbage reception facility.
- ☐ To develop the training course, research or development project regarding the managerial enhancement of garbage reception facility.
- ☐ To improve the process of planning, policy or related regulation regarding the prevention of marine pollution from ship-generated garbage.
- ☐ To develop the database regarding the operation of garbage reception facility.

The question Q11 is the consecutive question from the question Q10. If the answer is "Interest" in the question Q10, the respondents are required to select the topic that they would like to develop or improve through the collaborations with Laem Chabang Port. Contrarily, if the answer is "No interest", the respondents can skip this question to the next question. The statements in this section reflect the collaborations that is inferred from the finding of the work of Cho (2009), Chen and Liu (2013) and Lam and Notteboom (2014), the regulation of MARPOL convention and the existing practice explained in the report of Marine Department of Thailand.

Q12: Please recommend the other issues that you think are important.

The question Q12 is the open question aiming to gather the additional topics regarding the operation and the management of ship-generated garbage that the respondents would like to recommend.

3.5.2 Questionnaire part 2

Part 2 of the questionnaire was linked with the research objective 1 that aims to measure the current performance of the provision of garbage reception service of Laem Chabang Port. The statements were developed based on the parameters found in the regulation of MARPOL 78/78, the work of Song and Panayides (2008) and the interview of the officers working at Civil Engineering Division of Laem Chabang Port. The list is origanized into 6 topics – 1) the adequacy of garbage reception facility, 2) the quality of garbage reception service, 3) the ease of procedure, 4) the cost of garbage reception service, 5) the location of garbage reception facility, and 6) the information accessibility – which affect the overall satisfaction of the shipping firms. Hence, part 2 comprises of 6 subsections. The evaluation scale for each statement is based on the direction in the work of Lai et al. (2014) who used the Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree). The detail of the statements in the questionnaire part 2 is explained in Table 3.2-Table 3.7.

Table 3.2 Section 1 of questionnaire part 2

Please indicate the degree of your agreement or disagreement to the following statements.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
The adequacy of garbage reception facility						
R1A1	The reception facility of LCP can receive all amount of the victual and domestic waste.					
R1A2	The reception facility of LCP can receive all amount of the operational waste.					
R1A3	The reception facility of LCP is always ready to operate.					
R1A4	The transfer of ship-generated garbage to the reception facility is done by you.					

Section 1 of the questionnaire part 2 is comprised of the statements R1A1- R1A4 aiming to evaluate the current adequacy of the garbage reception facility of Laem Chabang Port based on the readiness of service, which affects the environmental performance and the velocity of the service.

Table 3.3 Section 2 of questionnaire part 2

Please indicate the degree of your agreement or disagreement to the following statements.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
The quality of service						
R1B1	The operation of garbage reception service does not make any delay to the operation of ship.					
R1B2	The collecting service is done in the agreed date, time and place.					
R1B3	The garbage reception facility and its operation in LCP does not aggravate the marine pollution in and around port area.					

Section 2 the questionnaire part 2 contains the statements R1B1- R1B3 aiming to evaluate the service quality of the garbage reception facility of Laem Chabang Port based on the delay of ship, commitment to provide the service and its ability to prevent marine pollution, which affects the satisfaction of the shipping firms.

Table 3.4 Section 3 of questionnaire part 2

Please indicate the degree of your agreement or disagreement to the following statements.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
The ease of procedure						
R1C1	The procedure of garbage reception service is not complicated.					
R1C2	The notification form and other documents are easy to fill in.					
R1C3	You need to submit the electronic notification form and other documents rather than paper.					

Section 3 the questionnaire part 2 includes the statements R1C1- R1C3 aiming to evaluate the ease of procedure to use reception facility of Laem Chabang Port which affects the satisfaction of the shipping firms.

Table 3.5 Section 4 of questionnaire part 2

Please indicate the degree of your agreement or disagreement to the following statements.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
The cost of service						
R1D1	You think that the cost of garbage reception service is reasonable and you are willing to pay for it. (150 Baht/vessel/day for transferring by truck from the general cargo ship, container ship and coastal ship to the reception facility)					
R1D2	You think that the cost of garbage reception service is reasonable and you are willing to pay for it. (500 Baht/vessel/day for transferring by truck from bulk carrier to the reception facility)					
R1D3	You think that the cost of garbage reception service for the mooring ship is reasonable and you are willing to pay for it. (2,000 Baht/vessel/day for by barge from mooring ship to the reception facility)					
R1D4	All ships in LCP should be charged for the garbage reception service, whether they deliver garbage to the reception facility or not.					
R1D5	The ships that do not deliver their garbage at the reception facility should not be charged.					

Section 4 the questionnaire part 2 consists of the statements R1D1- R1D5 aiming to evaluate the cost of garbage reception service of Laem Chabang Port based on the current port tariff used for transferring the garbage by truck or by barge from the container ship, general cargo ship, coastal ship and bulk carrier to the reception facility. Besides, the opinion of the shipping firms on the practice is also included in the questionnaire, in order to use it in the policy implication.

Table 3.6 Section 5 of questionnaire part 2

Please indicate the degree of your agreement or disagreement to the following statements.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Location of the reception facility						
R1E1	It is comfortable for you to find the location of the garbage reception service center in LCP.					
R1E2	The location of garbage reception service center causes delay to the operation of ship.					
R1E3	The operations of garbage reception service will be finished faster, if the					

Please indicate the degree of your agreement or disagreement to the following statements.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Location of the reception facility						
	location of the garbage reception service center is known.					

Section 5 the questionnaire part 2 is comprised of the statements R1E1- R1E3 aiming to evaluate the effect of the current location of the service provision center on the operation of the shipping firm in term of convenience and operational performance.

Table 3.7 Section 6 of questionnaire part 2

Please indicate the degree of your agreement or disagreement to the following statements.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
The accessibility of garbage reception service information						
R1F1	It is easy for you to gain access to the information regarding the garbage reception service of LCP.					
R1F2	The decision to deliver your ship-generated garbage at LCP is made when you receive enough information about the service.					
R1F3	You know where you can gain access to the information regarding the garbage reception service of LCP.					

Section 6 the questionnaire part 2 includes the statement R1F1- R1F3 aiming to evaluate the current performance of Laem Chabang Port in terms of information regarding the garbage reception service, which affects the decision to deliver garbage of the shipping firms.

3.5.3 Questionnaire part 3

Part 3 of the questionnaire is organized based on the research objective 2 that aims to investigate the level of agreement or disagreement to the statements that reflect the motivation of the shipping firms in delivering ship-generated garbage at the garbage reception facility of Laem Chabang Port. The statements were developed based on the parameters explored in the previous literature including law, regulation (Knapp and Franses, 2009; Ng and Song, 2010), navigation limitation (Jones, 1995; Ball, 1999; Carpenter and Macgill, 2005), Cooperation (Cohen and Roussel, 2005), Competitiveness (Bateman, 1996; Song and Panayides, 2008; Lam and Notteboom, 2014), and Environmental consciousness (Cho, 2009; Chen and Liu, 2013). The list of statements; thus, comprises of 5 subsections, as presented in Table 3.8-Table 3.12. The evaluation scale for each statement is based on the direction in the work of Lai et al. (2014) who used the Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree). The detail of the statements is explained below.

Table 3.8 Section 1 of questionnaire part 3

Please indicate the degree of your agreement or disagreement to the following motivations that make you to deliver ship-generated garbage at LCP.		**Strongly disagree**	**Disagree**	**Not sure**	**Agree**	**Strongly agree**
Law and regulation						
R2A1	To abide by the international convention such as MARPOL and UNCLOS etc.					
R2A2	To abide by the national law of Thailand.					
R2A3	The flag state of Thailand – Marine Department - forces you to deliver ship-generated garbage at the reception facility of LCP.					
R2A4	The Marine Department forces you to deliver ship-generated garbage at the reception facility of LCP.					
R2A5	To abide by to environmental regulations and rules of LCP.					
R2A6	The flag state – foreign flag - forces you to deliver ship-generated garbage at the reception facility of LCP.					

Section 1 the questionnaire part 3 comprises of the statement R2A1- R2A6 aiming to evaluate the effect of both international and national law and regulation on the motivation of the shipping firms to deliver their garbage to the reception facility of Laem Chabang Port. Besides, the exercise of power of the related governmental agencies on the garbage –related operation is also evaluated.

Table 3.9 Section 2 of questionnaire part 3

Please indicate the degree of your agreement or disagreement to the following motivations that make you to deliver ship-generated garbage at LCP.		**Strongly disagree**	**Disagree**	**Not sure**	**Agree**	**Strongly agree**
Limitation of ship and port of call						
R2B1	LCP is the destination port.					
R2B2	The storage space onboard for keeping ship-generated garbage is not enough for keeping the garbage that will be generated during the trip to the next port of discharge.					
R2B3	The next port of discharge lacks the garbage reception facility resulting in the delay of ship.					
R2B4	The cost of garbage reception service is unreasonable.					
R2B5	The previous port of discharge lacks the garbage reception facility.					
R2B6	You will not deliver ship-generated garbage at LCP if its amount is not much and there is an ample of space for keeping garbage.					
R2B7	You have no choice, except LCP; therefore, you need to deliver ship-					

Please indicate the degree of your agreement or disagreement to the following motivations that make you to deliver ship-generated garbage at LCP.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Limitation of ship and port of call						
	generated garbage at the reception facility of LCP.					

Section 2 the questionnaire part 3 consists of the statement R2B1-R2B7 aiming to evaluate the effect of the limitation of ship, such as the storage space onboard, etc., on the motivation to deliver garbage at the reception facility of Laem Chabang Port. In addition, the limitation of the facility at different ports of call is also assessed, in order to see its effect on the decision of the shipping firms.

Table 3.10 Section 3 of questionnaire part 3

Please indicate the degree of your agreement or disagreement to the following motivations that make you to deliver ship-generated garbage at LCP.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Company policy						
R2C1	The firms' policy wants you to deliver ship-generated garbage at every port that you visit.					
R2C2	Your firm has a long term contract with LCP in using the garbage reception facility.					
R2C3	Your firm has a long term contract with other companies in using their garbage reception facility.					
R2C4	Delivery at the garbage reception facility of LCP can reduce cost and dwell time at port.					
R2C5	Your firm authorizes ship master or ship agent to decide whether to deliver ship-generated garbage or not.					

Section 3 the questionnaire part 3 includes the statement R2C1- R2C5 aiming to evaluate the effect of the policy of the shipping firms on the operation regarding the management of ship-generated garbage at Laem Chabang port, such as the person who is responsible for making decision to deliver garbage and the long term contract with port and so on.

Table 3.11 Section 4 of questionnaire part 3

Please indicate the degree of your agreement or disagreement to the following motivations that make you to deliver ship-generated garbage at LCP.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Service satisfaction						
R2D1	The garbage reception facility of LCP can receive all types of ship-generated garbage without any limitations.					

Please indicate the degree of your agreement or disagreement to the following motivations that make you to deliver ship-generated garbage at LCP.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
R2D2	The provision of garbage reception facility of LCP does not generate the delay to the operation of ship.					
R2D3	The contacting procedure is easy and the operation can be flexibly adjusted according to your demand.					
R2D4	The cost of garbage reception service of LCP is reasonable.					
R2D5	You receive an incentive from LCP for the delivery of ship-generated garbage at the garbage reception facility of LCP.					

Section 4 the questionnaire part 3 comprises of the statements R2D1- R2D5 with the aim to evaluate the effect of the service satisfaction of the shipping firms on the motivation to deliver the ship-generated garbage at the reception facility of Laem Chabang Port. The service satisfaction is based on the performance of garbage reception service as measured in part 2 of the questionnaire.

Table 3.12 Section 5 of questionnaire part 3

Please indicate the degree of your agreement or disagreement to the following motivations that make you to deliver ship-generated garbage at LCP.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Environmental conscious						
R2E1	Your ship can aggravate marine pollution.					
R2E2	Marine pollution prevention is the responsibility of the government.					
R2E3	Marine pollution prevention is the responsibility of the sea carrier.					
R2E4	The delivery of ship-generate garbage at the reception facility is a waste of time.					
R2E5	Ship-generated garbage is harmful to marine environment and aquatic wildlife.					
R2E6	You are pleased to deliver ship-generated garbage at the reception facility, in order to prevent marine pollution.					
R2E7	Garbage reception facility at port is important for the success of marine pollution prevention.					

Section 5 the questionnaire part 3 contains the statement R2E1-R2E7 aiming to evaluate the effect of the conscious of the shipping companies regarding the marine pollution prevention and the protection of aquatic wildlife on the motivation to deliver the ship-generated garbage at the reception facility of Laem Chabang Port.

3.5.4 Questionnaire part 4

Part 4 of the questionnaire was designed to answer the research objective 3 that aims to evaluate the existing collaborations in terms of level of orientation and the benefits of collaborations based on the theory of Cohen and Roussel (2005) who devide the collaborations into 4 levels; namely, 1) transactional collaborations, 2) cooperative collaborations, 3) coordinated collaborations, and 4) synchronized collaborations. Therefore, the list of the statements comprises of 4 subtopics in accordance with the level of collaborations. The statements reflecting the collaborations in the operation of ship-generated garbage are adjusted from the information in the report of Marine Department of Thailand, the interview of 2 staffs working at Civil Engineering Division of Laem Chabang Port and the field observation of the reseacher. The benefits of the collaborations between the shipping firms and the seaport in the operation and the management of ship-generated garbage are modified from the work of Plambeck (2012), Chang (2013), Yang et al. (2013), Hall et al. (2013), Mueller et al. (2014), Ascencio et al. (2014), Lai et al. (2014), Gibbs et al. (2014) and Rodrigues et al. (2015) who studied on the green supply chain in port. The evaluation scale for each statement is based on the direction in the work of Lai et al. (2014), who used the Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree). The detail of the statements is explained in Table 3.13- Table 3.16.

Table 3.13 Section 1 of questionnaire part 4

Please indicate the degree of your agreement or disagreement to the following statements.		**Strongly disagree**	**Disagree**	**Not sure**	**Agree**	**Strongly agree**
Transactional collaborations						
R3A1	You contact LCP only when you need to deliver ship-generated garbage.					
R3A2	The exchange of document with LCP depends on the manual system.					
R3A3	LCP continuously improves the communication process, in order to increase the efficiency of garbage reception service.					
R3A4	Your firm tries to reduce cost regarding the operation of ship-generated garbage, in order to reduce the total cost of the firm.					
R3A5	The notification form for the use of garbage reception facility is submitted to LCP by hand.					
R3A6	The procedure and notification for the use of garbage reception facility are set up by LCP.					
R3A7	Your company continuously improves the communication system, in order to reduce the operation time in collecting garbage from ship.					

Section 1 the questionnaire part 4 includes the statements R3A1, R3A2, R3A5 and R3A6 aiming to investigate the existing level of transactional collaborations – which is the weakest type of collaborations- between the shipping firms and Laem

Chabang Port in the delivery process of ship-generated garbage. It is also comprised of the statements R3A3, R3A4 and R3A7 requiring to explore the benefits creating from the transactional collaborations to both organizations. The respondents will be asked to give the level of agreement and disagreement to the given statements ranging from 1 (strongly disagree) to 5 (strongly agree).

Table 3.14 Section 2 of questionnaire part 4

Please indicate the degree of your agreement or disagreement to the following statements.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Cooperative collaborations						
R3B1	Your firm and LCP mutually develop and design the document form regarding the garbage reception service.					
R3B2	Your firms and LCP use the same document form, which can reduce the cost and time in collecting garbage from ship.					
R3B3	LCP shares the information that is useful for your firm in making the garbage management plan.					
R3B4	You submit the notification form for the use of garbage reception facility to LCP 24 hours prior to the ship's arrival.					
R3B5	Advance submission of the notification form can increase the efficiency of garbage management plan.					
R3B6	You can easily and comfortably download document forms and other information of LCP.					
R3B7	The submission system of the notification form to LCP is based on the EDI, Intranet and the Internet.					
R3B8	If the operation of ship-generated garbage is finished in time, there will not be any delay to the operation of ship.					

The statements R3B1, R3B3, R3B4 and R3B7 in section 2 of part 4; on the one hand, aim to inspect the existing level of cooperative collaborations – which reflect a higher effort in developing the transaction than that of the transactional collaborations - between the shipping firms and Laem Chabang Port in the delivery process of ship-generated garbage. On the other hand, the statement R3B2, R3B5, R3B6 and R3B8 require to explore the benefits creating from the cooperative collaborations to both organizations. The respondents will be asked to give the level of agreement and disagreement to the given statements ranging from 1 (strongly disagree) to 5 (strongly agree).

Table 3.15 Section 3 of questionnaire part 4

Please indicate the degree of your agreement or disagreement to the following statements.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Coordinated collaborations						
R3C1	LCP assists you in improving the communication system, technology and the management of ship-generated garbage.					
R3C2	You clearly know and understand the operation process regarding the ship-generated garbage because LCP has regularly noticed you.					
R3C3	Your firm set up the garbage management plan that corresponds to that of LCP.					
R3C4	The mutual improvement of ship-generated garbage management between your firm and LCP can reduce cost and time of the routine operation of ship.					
R3C5	Your firm normally negotiates and consults LCP in order to improve the collecting process.					
R3C6	The problem will be immediately solved once LCP knows your problem.					
R3C7	Your firm and LCP develop the short course training, research and development projects.					
R3C8	You think that the collaborations can generate the new body of knowledge, which increases the performance of the firm.					

The statements R3C1, R3C2, R3C3, R3C6, R3C7 in section 3 of part 4; on the one hand, aim to inspect the existing level of coordinated collaborations – which reflect a higher attempt in developing the ease of transaction, information technology, communication system and knowledge than that of the transactional and cooperative collaborations - between the shipping firms and Laem Chabang Port in the delivery process of ship-generated garbage. On the other hand, the statements R3C4, R3C5 and R3C8 require to explore the benefits creating from the coordinated collaborations to both organizations. The respondents will be asked to give the level of agreement and disagreement to the given statements ranging from 1 (strongly disagree) to 5 (strongly agree).

Table 3.16 Section 4 of questionnaire part 4

Please indicate the degree of your agreement or disagreement to the following statements.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Synchronized collaborations						
R3D1	Your firm, LCP and the other stakeholders make a plan and policy regarding the management of ship-generated garbage together.					
R3D2	The equipment and technology of LCP used for receiving ship-generated					

Please indicate the degree of your agreement or disagreement to the following statements.		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Synchronized collaborations						
	garbage are agreed by you and other stakeholders.					
R3D3	You think that the development of plan accepted by all stakeholders will increase the efficiency of the garbage reception service.					
R3D4	All stakeholders develop and use the same database and information technology.					
R3D5	Using the same database and information technology can increase the accuracy of plan and forecast.					
R3D6	Your firm and LCP understand and focus on the mutual interest rather than the individual interest.					
R3D7	The lack of collaborations will decrease the compatibility of port operators and sea carriers.					
R3D8	The collaborations regarding the management of ship-generated garbage can increase the ability to prevent marine pollution.					

The statements R3D1, R3D2, R3D4 and R3D6 in section 4 of part 4; on the one hand, aim to inspect the existing level of synchronized collaborations – which is the highest type of collaborations with strategic aims and partners - between the shipping firms and Laem Chabang Port in the delivery process of ship-generated garbage. On the other hand, the statements R3D3, R3D5, R3D7 and R3D8 require to explore the benefits creating from the synchronized collaborations to both organizations. The respondents will be asked to give the level of agreement and disagreement to the given statements ranging from 1 (strongly disagree) to 5 (strongly agree).

3.6 Summary of Research Methodology

The methodology including data collection, statistics for analysis, population and sampling technique is aligned with the research objective, research question and research hypothesis. The linkage of all research elements is depicted in Figure 3.9.

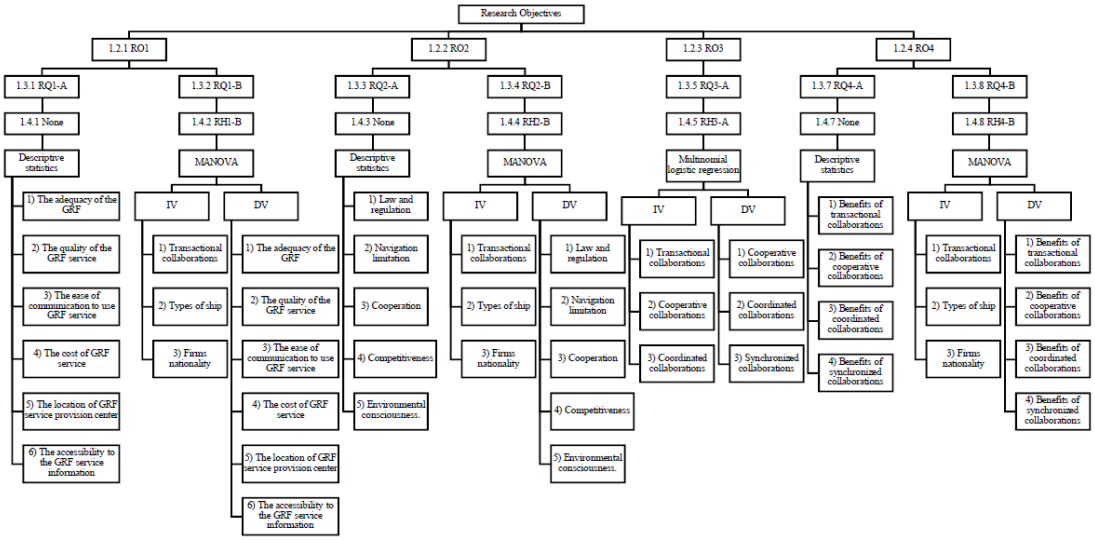

Figure 3.9 Alignment of research structures

In accordance with Figure 3.9, the variables included in different analytical methods of each research objective are linked. The detail of each variable and reasons why such the methods are adopted for attaining the research hypothesis are explained in 3.4-3.5.

CHAPTER IV
ANALYSIS

The content in Chapter 4 is organized into 5 main sections. In the first part of the chapter, the results of survey are summarized, while the second part explains that, by what means, the data is analyzed based on 4 research objectives. The statistics results and assumptions are heavily discussed in this section. The third part illustrates in what way research hypothesis is tested so as to answer the research questions. Thereinafter, the results obtained from the analysis are managerially interpreted using the scatter diagram presentation. The final section presents how the results are discussed for policy and practice implications based on the previous literature, regulations and implementations adopted by other seaports.

4.1 Results of the questionnaire survey

According to the questionnaire survey, approximately 95% percent of the respondents were interviewed by the author so as to verify their qualifications, with 5% of respondents assigned directly by the firms themselves. After that, the respondents were given a clear explanation relating to the major contribution of their information to the current literature and society as well as ensuring that respondent information will be kept confidential. The questionnaires were then communicated to the respondents by two means: 1) online questionnaire and 2) as an electronic file via e-mail, depending on the convenience of each respondent. Approximately 80% of the respondents preferred the latter choice. Respondents were requested to indicate the degree to which they agreed or disagreed to questionnaire statements reflecting the reasons for using the garbage reception facility at the LCP, using a Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire survey was conducted over a 6-month period from July to December 2015. The respondents took an average of 7 days to return the questionnaire. One month and three months after the first submission, those who did not respond, were followed up via telephone call. Finally, a total of 127 completed questionnaires were obtained from the respondents, representing a response rate of 85.81%.

4.2 Data analysis

4.2.1 Data analysis for research objective 1

There are 17 attributions in the dataset including R1A1, R1A3, R1A4, R1B1, R1B2, R1B3, R1C1, R1C2, R1C3, R1D1, R1D2, R1D3, R1D4, R1E1, R1E2, R1F1, and R1F3. The descriptive statistics of each attribution are shown in Table 4.1.

Table 4.1 Descriptive statistics for questionnaire part 2

Attribution	n	Minimum	Maximum	Average	Std. Deviation
R1A1	127	2.0	5.0	3.677	.6532
R1A3	127	1.0	5.0	3.402	1.0333
R1A4	127	1.0	4.0	2.205	.7595
R1B1	127	2.0	5.0	3.622	.8722

Attribution	n	Minimum	Maximum	Average	Std. Deviation
R1B2	127	2.0	5.0	3.583	.9036
R1B3	127	3.0	5.0	4.252	.6420
R1C1	127	3.0	5.0	4.150	.5920
R1C2	127	2.0	5.0	3.677	.6285
R1C3	127	2.0	5.0	3.654	1.0718
R1D1	127	2.0	5.0	4.291	.6913
R1D2	127	1.0	5.0	3.047	.8151
R1D3	127	1.0	5.0	2.669	.8267
R1D4	127	1.0	5.0	2.724	1.1246
R1E1	127	2.0	5.0	3.543	.6987
R1E2	127	1.0	5.0	2.740	.9016
R1F1	127	1.0	5.0	3.126	.7237
R1F3	127	1.0	5.0	3.150	.9846
Valid n (listwise)	127				

4.2.1.1 The 1st round of MANOVA for research objective 1

The first round of MANOVA aims to assess the impact of the levels of transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year) on the difference of the performance score in providing garbage reception facility (GRF) by Laem Chabang Port (LCP).

4.2.1.1.1 Assumption testing of the 1st round of MANOVA

The first assumption of MANOVA is multivariate normal distribution of dependent variables ($\underline{Y}$~N), which was tested by Mahalanobis distance. It was calculated through linear regression analysis, in order to explore whether there is any multivariate outlier (Pallant, 2002). Corresponding with the test, the maximum value of Mahalanobis distance (37.528) is greater than the critical values of chi-square at 17 degrees of freedom with α=0.05 (critical value=27.587). Based on this evidence, it can be concluded that there are multivariate outliers and the multivariate normal distribution is not held. Next assumption of MANOVA is the linear relationship among dependent variables. This postulate was investigated by using scatterplots between pairs of dependent variables. It is found that the relationship among dependent variables is not linear implying that this assumption is violated. It is known that MANOVA can work effectively when dependent variables are moderately related to one other (Pallant, 2002). Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were adopted to test this assumption. The value of Kaiser-Meyer-Olkin is .68 indicating a moderate association among dependent variables while the Bartlett's Test of Sphericity (χ^2=650.120, p<.000) shows statistical significance at α=5%. These results confirm the existence of the relationship among dependent variables. To further investigate the levels of relationship among dependent variables, the variance inflation factor (VIF) and Pearson Correlation were computed through linear regression analysis. Corresponding with the test, the value of VIF obtained from linear regression analysis is less than 10, which can be concluded that the relationship among dependent variables is not high and the multicollinearity do not exist. Likewise, the value of Pearson Correlation is less than .8 implying that the relationship among dependent variables is not strong. This result confirms that the multicollinearity assumption is not violated. The Homogeneity of variance-covariance matrices of $\underline{Y}$ for group i ; i=1, 2,..,k (Σ_1= Σ_2=… Σ_k) was tested by using Box's Test. According to the test, the value of Box's Test

(Box's M =324.324, F=1.588, p<.000) indicates the statistical significance at α=5% (p<.000) implying that the observed covariance matrices of the dependent variables are not equal across the groups. In other words, the Homogeneity of variance-covariance matrices is violated. Thereinafter, the error variance of an individual dependent variable was tested, in order to find whether it is equal across groups or not. To investigate this postulate, Levene's Test was used. Corresponding with the results, the Levene's test of most attributions indicates the satisfaction to this assumption (statistically significant at α=5%), except those of attribution R1A1 (p=.180), R1B2 (p=.076), R1D1 (p=.276), R1D3 (p=.238), R1D4 (p=.609) and R1E1 (p=.367), which indicate statistically insignificant at α=5%. This means that the error variance of these 6 dependent variable is equal across the groups, while the rest attributions violate this postulate. To remedy this violation, Tabachnick and Fidell (1983) recommended stipulating a more conservative level for alpha, in order to avoid Type one error. Therefore, the level of significance for testing statistical significance of the attribution R1A3, R1A4, R1B1, R1B3, R1C1, R1C2, R1C3, R1D2, R1E2, R1F1 and R1F3 was set more strictly at p=1% while that of the rest attributions was p=5%.

4.2.1.1.2 Results of the 1st round of MANOVA

The next step of MANOVA analysis is to pick up the suitable statistics for testing the overall effect of independent variables on the difference of dependent variables. As discussed in 4.2.1.1.1, the normality assumptions are not held, while the multivariate outlier is found. In addition, the linearity, homogeneity of variance-covariance matrices and equality of variance of a particular variable are violated. Based on these evidences, Pillai's Trace is selected due to the fact that Wilks' Lambda will be the most efficient when normality and homogeneity of variance-covariance matrices assumption are not violated, while Hotelling's Trace will be outstanding when the non-normality distribution is explored among dependent variables. Apart from other statistics, Roy's Largest Root adds a special postulate on the linear relationship of dependent variables, which is broken in this study. In accordance with the test, all statistics (p<.000), including Pillai's Trace, are statistically significant at α=.05 indicating that the independent variable (level of transactional collaborations or (high, moderate and low frequency of ships berthing at LCP per year) has an effect on the difference of scores (current performance of GRF service) between groups of the shipping firms at least one dependent variable. To further analyze this effect, F–test was computed for testing the effect of independent variables on a particular dependent variable. Corresponding with the test, the independent variable has an effect on the difference of score of 12 attributions, including R1A1, R1B1, R1B3, R1C1, R1C2, R1C3, R1D3, R1D4, R1E1, R1E2, R1F1 and R1F3, because they indicate statistical significance at α=.01. Contrarily, the rest of the attributions comprised of R1A3 (p=.560), R1A4 (p=.151), R1B2 (p=.700), R1D1 (p=.810) and R1D2 (p=.333), do not seem to be affected by the independent variable as their p scores are not significant at α=.01. The effect of independent variable was further analyzed by using parameter estimates obtained from MANOVA analysis, as presented in Table 4.2.

Table 4.2 Descriptive statistics and parameter estimates (levels of transactional collaborations)

Descriptive Statistics					Parameter Estimates				
Level of transactional collaboration		Average	Std. Deviation	n	B	t	Sig.	99% Confidence Interval	
								Lower Bound	Upper Bound
R1A1	Low	3.810	.6107	84	.143	.819	.414	-.445	.731
	Moderate	3.286	.7127	28	-.381	-1.914	.058	-1.052	.290
	High	3.667	.4880	15	0[a]				
	Total	3.677	.6532	127					
R1A3	Low	3.417	1.1429	84	-.183	-.631	.529	-1.163	.796
	Moderate	3.250	.7993	28	-.350	-1.055	.293	-1.468	.768
	High	3.600	.7368	15	0[a]				
	Total	3.402	1.0333	127					
R1A4	Low	2.298	.8033	84	.231	1.093	.277	-.481	.943
	Moderate	2.000	.6667	28	-.067	-.276	.783	-.880	.747
	High	2.067	.5936	15	0[a]				
	Total	2.205	.7595	127					
R1B1	Low	3.738	.9199	84	1.071	4.750	.000***	.311	1.832
	Moderate	3.786	.4987	28	1.119	4.346	.000***	.251	1.987
	High	2.667	.4880	15	0[a]				
	Total	3.622	.8722	127					
R1B2	Low	3.631	.8751	84	.164	.645	.520	-.694	1.022
	Moderate	3.500	1.0715	28	.033	.115	.909	-.946	1.013
	High	3.467	.7432	15	0[a]				
	Total	3.583	.9036	127					
R1B3	Low	4.452	.6093	84	.519	3.187	.002***	-.030	1.068
	Moderate	3.821	.4756	28	-.112	-.602	.548	-.738	.515
	High	3.933	.5936	15	0[a]				
	Total	4.252	.6420	127					
R1C1	Low	4.333	.5452	84	.733	4.928	.000***	.232	1.235
	Moderate	3.893	.4973	28	.293	1.724	.087	-.280	.865
	High	3.600	.5071	15	0[a]				
	Total	4.150	.5920	127					
R1C2	Low	3.643	.6140	84	.443	2.694	.008***	-.111	.997
	Moderate	4.036	.5762	28	.836	4.453	.000***	.203	1.468
	High	3.200	.4140	15	0[a]				
	Total	3.677	.6285	127					
R1C3	Low	3.310	1.1083	84	-.890	-3.298	.001***	-1.800	.020
	Moderate	4.393	.6289	28	.193	.626	.533	-.846	1.232
	High	4.200	.4140	15	0[a]				
	Total	3.654	1.0718	127					
R1D1	Low	4.274	.6829	84	-.126	-.647	.519	-.784	.531
	Moderate	4.286	.8100	28	-.114	-.513	.609	-.865	.636
	High	4.400	.5071	15	0[a]				
	Total	4.291	.6913	127					
R1D2	Low	3.083	.7478	84	-.117	-.511	.610	-.886	.653
	Moderate	2.857	.8483	28	-.343	-1.316	.191	-1.221	.536
	High	3.200	1.0823	15	0[a]				
	Total	3.047	.8151	127					
R1D3	Low	2.560	.7339	84	.093	.415	.679	-.662	.848
	Moderate	3.107	.9165	28	.640	2.506	.014**	-.221	1.502
	High	2.467	.9155	15	0[a]				
	Total	2.669	.8267	127					
R1D4	Low	2.393	.8920	84	-.007	-.027	.978	-.898	.884
	Moderate	3.893	1.0659	28	1.493	4.947	.000***	.476	2.510
	High	2.400	.9856	15	0[a]				
	Total	2.724	1.1246	127					
R1E1	Low	3.333	.5668	84	2.5E-15	.000	1.000	-.548	.548
	Moderate	4.286	.6587	28	.952	5.132	.000***	.327	1.578
	High	3.333	.4880	15	0[a]				
	Total	3.543	.6987	127					
R1E2	Low	2.643	.8161	84	-.824	-3.385	.001***	-1.644	-.004
	Moderate	2.643	1.0959	28	-.824	-2.966	.004***	-1.760	.112
	High	3.467	.6399	15	0[a]				
	Total	2.740	.9016	127					

Descriptive Statistics					Parameter Estimates				
Level of transactional collaboration		Average	Std. Deviation	n	B	t	Sig.	99% Confidence Interval	
								Lower Bound	Upper Bound
R1F1	Low	3.024	.6205	84	.024	.121	.904	-.639	.686
	Moderate	3.500	1.0000	28	.500	2.229	.028	-.256	1.256
	High	3.000	.3780	15	0[a]				
	Total	3.126	.7237	127					
R1F3	Low	2.929	1.0154	84	-.138	-.538	.591	-1.003	.727
	Moderate	3.857	.7559	28	.790	2.698	.008***	-.197	1.778
	High	3.067	.4577	15	0[a]				
	Total	3.150	.9846	127					

Remark [a] The base group.
*** Statistically significant at the .01 level.

In accordance with Table 4.2, the effect of independent variable on the difference of the score between the Low and the Moderate Groups (as the comparing group) and the High Group (as the base group) is identified. Firstly, the Low and Moderate groups are statistically different from the base group in attribution R1B1, R1C2 and R1E2, while the Low group is statistically different from the base group in attribution R1B3, R1C1 and R1C3. Contrarily, the attributions R1D3, R1D4, R1E1 and R1F3 indicate the significant difference of the performance score between the Moderate and the High Groups. Thereinafter, the difference of scores between the Low and the Moderate Groups was analyzed by using post hoc test. The equal variance is not assumed in the post hoc test as the results of Box's Test and Levene's Test obviously indicate the violation of this assumption. Therefore, the test is based on Games-Howell test which the inequality of variance is assumed. The result of post hoc test is presented in Table 4.3.

Table 4.3 Post hoc test between Low and Moderate groups (levels of transactional collaborations)

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
						Lower Bound	Upper Bound
R1A1	Low	Moderate	.524	.1503	.003***	-.062	1.110
R1A3	Low	Moderate	.167	.1959	.673	-.572	.906
R1A4	Low	Moderate	.298	.1535	.137	-.288	.883
R1B1	Low	Moderate	-.048	.1377	.936	-.561	.465
R1B2	Low	Moderate	.131	.2239	.829	-.745	1.007
R1B3	Low	Moderate	.631	.1118	.000***	.206	1.056
R1C1	Low	Moderate	.440	.1112	.001***	.014	.867
R1C2	Low	Moderate	-.393	.1278	.010***	-.884	.099
R1C3	Low	Moderate	-1.083	.1696	.000***	-1.716	-.450
R1D1	Low	Moderate	-.012	.1702	.997	-.676	.653
R1D2	Low	Moderate	.226	.1799	.427	-.474	.926
R1D3	Low	Moderate	-.548	.1908	.018**	-1.295	.200
R1D4	Low	Moderate	-1.500	.2237	.000***	-2.374	-.626
R1E1	Low	Moderate	-.952	.1390	.000***	-1.494	-.410
R1E2	Low	Moderate	.000	.2254	1.000	-.887	.887
R1F1	Low	Moderate	-.476	.2007	.059	-1.273	.321
R1F3	Low	Moderate	-.929	.1808	.000***	-1.613	-.244

Remark **, *** Statistically significant at the .05 level and .01 level respectively.

According to Table 4.3, 8 attributions out of 17 attributions indicate the statistical significance at α=1% implying that the score between the Low and the Moderate Groups is different. These attributions are R1A1, R1B3, R1C1, R1C2, R1C3, R1D4, R1E1 and R1F3 because their p score are significant at α=.01 whereas the R1D3 is statistically significant at α=5%. In contrast, the rest attributions, including R1A3

(p=.673), R1A4 (p=.137), R1B1 (p=.936), R1B2 (p=.829), R1D1 (p=.997), R1D2 (p=.427), R1E2 (p=1.000) and R1F1 (p=.059), are not significant at α=.01. This implies that the scores between the Low and the Moderate Groups are not affected the independent variable.

4.2.1.2 The 2nd round of MANOVA analysis for research objective 1

The second round of MANOVA aims to assess the impact of nationality of shipping firms on the difference of the performance scores in providing GRF services by LCP.

4.2.1.2.1 Assumption testing of the 2nd round of MANOVA

The multivariate normal distribution ($\underline{Y}$~N) and outlier was tested by using Mahalanobis distance obtained from linear regression analysis. The maximum value of Mahalanobis distance (37.528) is higher than the critical values of chi-square at 17 degrees of freedom with α=0.05 (critical value=27.587). Based on this evidence, it can be concluded that there is multivariate outliers and the multivariate normal distribution assumption is not satisfied. The linearity assumption was investigated by using scatterplots between pairs of dependent variables. It is found that the dependent variables are not linearly related. This means that this linearity assumption is not held. The Kaiser-Meyer-Olkin is moderate (KMO=.68) as well as the Pearson Correlation is less than .8 implying that the relationship among dependent variables is not strong. In addition, the low value of VIF implies that there is no multicollinearity problem. The Homogeneity of variance-covariance matrices of $\underline{Y}$ for group i ; i=1, 2,..,k ($\Sigma_1 = \Sigma_2 = \ldots \Sigma_k$) was tested by using Box's Test. According to the test, the value of Box's Test (Box's M=205.095, F=.982, p=.546) indicates no statistical significance at α=5% implying that the observed covariance matrices of the dependent variables are equal across groups. Afterwards, the error variance of an individual dependent variable was further tested in order to investigate whether the error variance is equal across groups or not. To examine this postulate, Levene's Test was applied. In accordance with the results, all values of Levene's test indicate no statistical significance at α=5% meaning that the error variance of all attributions is equal across groups. Thus, the level of significance at 5% is used for testing all attributions in the 2nd round of MANOVA analysis.

4.2.1.2.2 Results of the 2nd round of MANOVA

Next step in the 2nd round of MANOVA analysis is to select the right statistics to examine the overall effect of independent variables on the difference of dependent variables. As discussed in 4.2.1.2.1, the linearity and normality assumptions are not held, whereas the rest assumptions of MANOVA are satisfied. Corresponding with these evidences, Wilks' Lambda is the most suitable statistics for this situation. Wilks' Lambda (p=.561) indicates statistical insignificance at α=5% meaning that the independent variable (firms' nationality) has no effect on the distinction of the performance score. To further analyze in more detail, the F-test was generated for examining if the independent variable affect the individual performance

score or not. Corresponding with the test, all attributions indicate the low value of F-test, which results in statistical insignificance at α=.05, except the attribution R1D4 and R1F3. This means that the score in these 2 attributions are affected by the independent variable. After that, the impact of independent variable was further analyzed by using parameter estimates obtained from MANOVA analysis, as presented in Table 4.4.

Table 4.4 Descriptive statistics and parameter estimates (nationality of firms)

Descriptive Statistics					Parameter Estimates				
Nationality		Average	Std. Deviation	n	B	t	Sig.	95% Confidence Interval	
								Lower Bound	Upper Bound
R1A1	Foreign	3.653	.6699	101	-.116	-.805	.422	-.601	.369
	Thai	3.769	.5870	26	0[a]				
	Total	3.677	.6532	127					
R1A3	Foreign	3.426	1.0329	101	.118	.518	.605	-.650	.886
	Thai	3.308	1.0495	26	0[a]				
	Total	3.402	1.0333	127					
R1A4	Foreign	2.178	.7402	101	-.129	-.774	.440	-.693	.434
	Thai	2.308	.8376	26	0[a]				
	Total	2.205	.7595	127					
R1B1	Foreign	3.594	.8268	101	-.137	-.711	.478	-.784	.511
	Thai	3.731	1.0414	26	0[a]				
	Total	3.622	.8722	127					
R1B2	Foreign	3.614	.8941	101	.152	.765	.446	-.518	.823
	Thai	3.462	.9479	26	0[a]				
	Total	3.583	.9036	127					
R1B3	Foreign	4.208	.6529	101	-.215	-1.532	.128	-.688	.258
	Thai	4.423	.5778	26	0[a]				
	Total	4.252	.6420	127					
R1C1	Foreign	4.129	.5944	101	-.102	-.783	.435	-.541	.337
	Thai	4.231	.5870	26	0[a]				
	Total	4.150	.5920	127					
R1C2	Foreign	3.673	.6498	101	-.019	-.137	.891	-.487	.449
	Thai	3.692	.5491	26	0[a]				
	Total	3.677	.6285	127					
R1C3	Foreign	3.723	1.0404	101	.338	1.441	.152	-.453	1.129
	Thai	3.385	1.1688	26	0[a]				
	Total	3.654	1.0718	127					
R1D1	Foreign	4.297	.6862	101	.028	.182	.856	-.487	.542
	Thai	4.269	.7243	26	0[a]				
	Total	4.291	.6913	127					
R1D2	Foreign	3.059	.8225	101	.059	.330	.742	-.547	.666
	Thai	3.000	.8000	26	0[a]				
	Total	3.047	.8151	127					
R1D3	Foreign	2.683	.8477	101	.068	.372	.711	-.547	.683
	Thai	2.615	.7524	26	0[a]				
	Total	2.669	.8267	127					
R1D4	Foreign	2.842	1.1466	101	.572	2.356	.020**	-.246	1.391
	Thai	2.269	.9190	26	0[a]				
	Total	2.724	1.1246	127					
R1E1	Foreign	3.594	.7096	101	.248	1.624	.107	-.267	.762
	Thai	3.346	.6288	26	0[a]				
	Total	3.543	.6987	127					
R1E2	Foreign	2.792	.8980	101	.254	1.282	.202	-.413	.920
	Thai	2.538	.9047	26	0[a]				
	Total	2.740	.9016	127					
R1F1	Foreign	3.149	.7401	101	.110	.690	.491	-.427	.647
	Thai	3.038	.6622	26	0[a]				
	Total	3.126	.7237	127					
R1F3	Foreign	3.238	1.0015	101	.430	2.009	.047**	-.291	1.151
	Thai	2.808	.8494	26	0[a]				
	Total	3.150	.9846	127					

Remark [a] The base group.
** The difference is statistically significant at the .05 level.

In accordance with Table 4.4, the parameter estimations of all attributions indicate no statistical insignificance at α=5%, except those of attribution R1D4 and R1F3, which show statistical significance at α=5% indicating that they are affected by the independent variable – shipping firms' nationality.

4.2.1.3 The 3rd round of MANOVA for research objective 1

The third round of MANOVA aims to investigate the impact of the types of ships on the difference of the performance score of GRF service provided by LCP.

4.2.1.3.1 Assumption testing of the 3rd round MANOVA

The multivariate normal distribution ($\underline{Y}$~N) and outlier was tested by using Mahalanobis distance, which was obtained from linear regression analysis. According to the test, the maximum value of Mahalanobis distance (37.528) obtained from linear regression is higher than the critical values of chi-square at 17 degrees of freedom with α=0.05 (critical value = 27.587). Based on this evidence, it can be concluded that the multivariate outliers and multivariate normal distribution assumptions are not held. The linear association was investigated by using scatterplots between pairs of dependent variables. Ihe scatterplots indicate that the dependent variables are not linearly related. This implies that the linearity assumption is violated. The Kaiser-Meyer-Olkin is moderate (KMO=.68) and the Pearson Correlation is less than .8. These results imply that the relationship among dependent variables is not strong. In addition, the low value of VIF implies that there is no multicollinearity problem in an analysis. Box's Test was adopted to test Homogeneity of variance-covariance matrices of $\underline{Y}$ and. According to the test, the value of Box's Test (Box's M=485.443, F=1.155, p=.034) indicates statistical significance at α=5% resulting in rejection of null hypothesis. This means that the observed covariance matrices of the dependent variables are not equal across groups and the Homogeneity of variance-covariance matrices is not held. Afterwards, Levene's Test was applied to test the error variance of an individual dependent variable. In accordance with the outcomes, most of Levene's test indicate no statistical significance at α=5% meaning that the error variance of them is equal across groups. However, only 4 attributions, including R1C3 (p=.031), R1D2 (p=.033), R1D3 (p=.023) and R1E1 (p=.002), indicate that their Levene's test is statistically significant at α=5%, which means that the error variance of these attributions are not equal across the groups of the independent variable. In order to avoid Type one error, Tabachnick and Fidell (1983) suggested to stipulate a more conservative level of significance (α). Thus, the alpha was determined more strictly at p=.01 instead of the normal p=.05 for testing significance of R1C3, R1D2, R1D3 and R1E1 in the 3rd round of MANOVA analysis.

4.2.1.3.2 Results of the 3rd round of MANOVA analysis

The statistics for testing the overall effect of the independent variable on the difference of the performance score will be selected based on the test of hypothesis discussed in 4.2.1.3.1. According to the test, only multicollinearity assumptions is satisfied. Contrarily, the linearity, the multivariate normal distribution

and the Homogeneity of variance-covariance matrices assumptions are violated, while the multivariate outlier is found. With these test results, the statistics of Pillai's Trace should be opted for this task. Based on the result, Pillai's Trace indicates statistical significance at α=5% not α=1%, which is not the appropriate alpha when the error variance tested by Levene's Test was violated. Therefore, it can be concluded that the performance score (dependent variable) is not affected by the type of ship (independent variable) at level of significance α=1%. According to the test, the attribution R1A3 (p=.01), R1C1 (p=.008), R1C3 (p<.000) and R1F3 (p<.000) show the statistical significance at α=1%, while the attribution R1A1 is statistically significant α=5% indicating that they are affected by the influence of independent variable. The rest attributions, including R1A4 (p=.951), R1B1 (p=.428), R1B2 (p=.057), R1B3 (p=.841), R1C2 (p=.331), R1D1 (p=.074), R1D2 (p=.541), R1D3 (p=.799), R1D4 (p=.477), R1E1 (p=.142), R1E2 (p=.202) and R1F1 (p=.110), are not significant at α=1%, which means that they are not influenced by the independent variable. It is noticed that there is the conflict between Pillai's Trace and the Tests of between-subjects effects. Thus, the Parameter Estimates of MANOVA, as shown in Table 4.5, are very considerable for testing whether the independent variable has an effect on the difference of the performance score or not.

Table 4.5 Descriptive statistics and parameter estimates (types of ships)

Descriptive Statistics					Parameter Estimates				
	Ship Type	Average	SD	n	B	t	Sig.	99% Confidence Interval	
								Lower Bound	Upper Bound
R1A1	General Cargo	3.885	.5883	26	.255	1.454	.149	-.336	.846
	Container Ship	3.638	.6127	58	.008	.056	.956	-.493	.510
	Bulk Carrier	3.714	.7263	14	.085	.403	.688	-.624	.794
	Vehicles Carrier/RoRo	2.500	.7071	2	-1.130	-2.415	.017**	-2.707	.448
	≥2 types	3.630	.6877	27	0[a]				
	Total	3.677	.6532	127					
R1A3	General Cargo	3.038	.9992	26	-.369	-1.349	.180	-1.291	.553
	Container Ship	3.655	1.0354	58	.248	1.069	.287	-.534	1.029
	Bulk Carrier	2.857	.9493	14	-.550	-1.679	.096	-1.655	.555
	Vehicles Carrier/RoRo	4.500	.7071	2	1.093	1.498	.042**	-1.366	3.552
	≥2 types	3.407	.9306	27	0[a]				
	Total	3.402	1.0333	127					
R1A4	General Cargo	2.115	.8162	26	-.107	-.505	.614	-.820	.606
	Container Ship	2.224	.7265	58	.002	.011	.991	-.603	.607
	Bulk Carrier	2.214	.8018	14	-.008	-.031	.975	-.863	.847
	Vehicles Carrier/RoRo	2.500	.7071	2	.278	.493	.623	-1.624	2.180
	≥2 types	2.222	.8006	27	0[a]				
	Total	2.205	.7595	127					
R1B1	General Cargo	3.462	.9892	26	-.316	-1.319	.190	-1.125	.492
	Container Ship	3.586	.8172	58	-.192	-.942	.348	-.877	.494
	Bulk Carrier	3.643	.8419	14	-.135	-.469	.640	-1.104	.834
	Vehicles Carrier/RoRo	4.500	.7071	2	.722	1.129	.261	-1.434	2.879
	≥2 types	3.778	.8916	27	0[a]				
	Total	3.622	.8722	127					
R1B2	General Cargo	3.154	.8339	26	-.550	-2.262	.025**	-1.370	.270
	Container Ship	3.655	.9652	58	-.049	-.235	.814	-.744	.646
	Bulk Carrier	3.714	.8254	14	.011	.036	.971	-.972	.993
	Vehicles Carrier/RoRo	4.500	.7071	2	.796	1.228	.222	-1.390	2.982
	≥2 types	3.704	.7753	27	0[a]				
	Total	3.583	.9036	127					
R1B3	General Cargo	4.346	.6288	26	.087	.487	.627	-.514	.688
	Container Ship	4.190	.6057	58	-.070	-.461	.646	-.579	.440
	Bulk Carrier	4.286	.7263	14	.026	.124	.902	-.694	.747
	Vehicles Carrier/RoRo	4.500	.7071	2	.241	.506	.613	-1.362	1.844

Descriptive Statistics					Parameter Estimates				
	Ship Type	Average	SD	n	B	t	Sig.	99% Confidence Interval	
								Lower Bound	Upper Bound
	≥2 types	4.259	.7121	27	0[a]				
	Total	4.252	.6420	127					
R1C1	General Cargo	4.462	.5818	26	.350	2.242	.027**	-.177	.877
	Container Ship	3.983	.6067	58	-.128	-.969	.335	-.575	.318
	Bulk Carrier	4.286	.4688	14	.175	.932	.353	-.457	.806
	Vehicles Carrier/RoRo	4.500	.7071	2	.389	.933	.353	-1.017	1.794
	≥2 types	4.111	.5064	27	0[a]				
	Total	4.150	.5920	127					
R1C2	General Cargo	3.692	.6177	26	.137	.794	.429	-.444	.718
	Container Ship	3.707	.6215	58	.151	1.036	.302	-.341	.644
	Bulk Carrier	3.643	.6333	14	.087	.423	.673	-.609	.783
	Vehicles Carrier/RoRo	4.500	.7071	2	.944	2.056	.042**	-.605	2.493
	≥2 types	3.556	.6405	27	0[a]				
	Total	3.677	.6285	127					
R1C3	General Cargo	3.077	.9767	26	-.627	-2.311	.022	-1.541	.288
	Container Ship	4.034	.8779	58	.331	1.439	.153	-.445	1.106
	Bulk Carrier	2.929	.9972	14	-.775	-2.385	.019	-1.871	.321
	Vehicles Carrier/RoRo	4.500	.7071	2	.796	1.101	.273	-1.643	3.235
	≥2 types	3.704	1.2030	27	0[a]				
	Total	3.654	1.0718	127					
R1D1	General Cargo	4.192	.6939	26	-.215	-1.154	.251	-.844	.414
	Container Ship	4.310	.6545	58	-.097	-.614	.540	-.630	.436
	Bulk Carrier	4.357	.8419	14	-.050	-.225	.822	-.804	.703
	Vehicles Carrier/RoRo	3.000	1.4142	2	-1.407	-2.830	.005***	-3.084	.270
	≥2 types	4.407	.5724	27	0[a]				
	Total	4.291	.6913	127					
R1D2	General Cargo	2.808	.6337	26	-.303	-1.350	.180	-1.061	.454
	Container Ship	3.086	.9039	58	-.025	-.131	.896	-.668	.618
	Bulk Carrier	3.214	.4258	14	.103	.383	.702	-.805	1.012
	Vehicles Carrier/RoRo	3.000	1.4142	2	-.111	-.185	.853	-2.132	1.910
	≥2 types	3.111	.8916	27	0[a]				
	Total	3.047	.8151	127					
R1D3	General Cargo	2.538	.7060	26	-.054	-.236	.814	-.827	.719
	Container Ship	2.741	.9654	58	.149	.765	.446	-.507	.804
	Bulk Carrier	2.714	.7263	14	.122	.443	.659	-.805	1.048
	Vehicles Carrier/RoRo	3.000	1.4142	2	.407	.666	.507	-1.655	2.470
	≥2 types	2.593	.6360	27	0[a]				
	Total	2.669	.8267	127					
R1D4	General Cargo	2.500	1.0296	26	-.130	-.419	.676	-1.174	.914
	Container Ship	2.879	1.1094	58	.250	.951	.343	-.635	1.135
	Bulk Carrier	2.571	.9376	14	-.058	-.157	.876	-1.309	1.193
	Vehicles Carrier/RoRo	3.500	2.1213	2	.870	1.054	.294	-1.914	3.655
	≥2 types	2.630	1.2755	27	0[a]				
	Total	2.724	1.1246	127					
R1E1	General Cargo	3.269	.5335	26	-.323	-1.704	.091	-.963	.316
	Container Ship	3.655	.6896	58	.063	.389	.698	-.480	.605
	Bulk Carrier	3.429	.6462	14	-.164	-.721	.472	-.931	.603
	Vehicles Carrier/RoRo	4.000	0.0000	2	.407	.805	.422	-1.299	2.114
	≥2 types	3.593	.8439	27	0[a]				
	Total	3.543	.6987	127					
R1E2	General Cargo	2.385	.8038	26	-.356	-1.449	.150	-1.185	.472
	Container Ship	2.897	.9857	58	.156	.748	.456	-.547	.858
	Bulk Carrier	2.714	.6112	14	-.026	-.090	.929	-1.020	.967
	Vehicles Carrier/RoRo	3.000	0.0000	2	.259	.396	.693	-1.951	2.469
	≥2 types	2.741	.9027	27	0[a]				
	Total	2.740	.9016	127					
R1F1	General Cargo	3.077	.6276	26	-.071	-.363	.717	-.732	.590
	Container Ship	3.103	.8098	58	-.045	-.269	.788	-.605	.516
	Bulk Carrier	3.071	.4746	14	-.077	-.327	.745	-.869	.715
	Vehicles Carrier/RoRo	4.500	.7071	2	1.352	2.586	.011**	-.411	3.114
	≥2 types	3.148	.6624	27	0[a]				
	Total	3.126	.7237	127					

Descriptive Statistics					Parameter Estimates				
	Ship Type	Average	SD	n	B	t	Sig.	99% Confidence Interval	
								Lower Bound	Upper Bound
R1F3	General Cargo	2.731	1.0023	26	-.417	-1.654	.101	-1.268	.433
	Container Ship	3.448	.9210	58	.300	1.403	.163	-.421	1.022
	Bulk Carrier	2.500	.8549	14	-.648	-2.143	.034**	-1.668	.372
	Vehicles Carrier/RoRo	4.500	.7071	2	1.352	2.009	.047**	-.917	3.621
	≥2 types	3.148	.8640	27	0[a]				
	Total	3.150	.9846	127					

Remark [a] The base group.
*** Statistically significant at the .01 level.

Corresponding with Table 4.5, there are 6 attributions - R1A1, R1B2, R1C1, R1C2, R1F1 and R1F3 - indicating statistical significance at the 5% level, while the attribution R1C3, R1D2, R1D3 and R1E1, which violate the error variance of an individual dependent variable do not show the statistical significance at α=1% meaning that their scores are not affected by the independent variable. The attributions R1A1, R1C2 and R1F1 indicate that the score evaluated by the Ro-RO vessel group statistically differ from that evaluated by the base group, whereas the attributions R1B2 and R1C1 indicate that the score evaluated by the general cargo vessel group statistically differ from that evaluated by the base group. In contrast, the attribution R1F3 indicates that the score evaluated by both the Ro-RO vessel group and bulk carrier group statistically differ from that evaluated by the base group.

Nevertheless, the parameter estimates in Table 4.5 do not test the effect of the independent variable on the difference of score among the 4 comparing groups - general Cargo, container Ship, bulk Carrier and vehicles Carrier/RoRo. Therefore, the post hoc test was conducted in order to investigate if there is the difference of the performance score among these 4 groups or not. Corresponding with the test, there are only 5 attributions – R1C1, R1C3, R1E1, R1E2 and R1F3 - indicating statistical significance at α=1%. The first attribution is R1C1 (p=.01) shows the statistical significance of the score between general cargo group and container ship group. The second attribution is R1C3, which demonstrates that the performance score between general cargo vessel operators and container ship operators (p<.000) as well as between the container ship operators and bulk carrier (p=.01), significantly differs from each other at α=1%. The third attribution is attribution R1E1 which illustrates the difference of the performance score between the operators of general cargo vessel and the operators of Ro-RO vessel (p<.000) as well as between the container ship operators and the Ro-RO vessel operators (p=.003). The next attribution is R1E2 indicating the statistical significance between general cargo vessel and the operators of Ro-RO vessel (p<.005). The final attribution is R1F3 that demonstrates the statistical significance between general cargo vessel operators and container ship operators (p=.026) as well as between container ship operators and bulk carrier (p=.011). Contrarily, the rest attributions indicate statistical insignificance at α=5% or 1% meaning that their performance scores (dependent variable) are not affected by the type of ship (independent variable).

4.2.2 Data analysis for research objective 2

There are 29 attributions in the dataset including R2A1, R2A2, R2A3, R2A4, R2A5, R2B1, R2B2, R2B3, R2B4, R2B5, R2B6, R2B7, R2C1, R2C2, R2C3, R2C4,

R2C5, R2D1, R2D2, R2D3, R2D4, R2D5, R2E1, R2E2, R2E3, R2E4, R2E5, R2E6 and R2E7. The descriptive statistics of each attribution are shown in Table 4.6.

Table 4.6 Descriptive statistics for questionnaire part 3

	n	Minimum	Maximum	Average	Std. Deviation
R2A1	127	2.0	5.0	4.323	.6887
R2A2	127	2.0	5.0	3.803	.9347
R2A3	127	1.0	4.0	2.331	.7459
R2A4	127	1.0	4.0	2.520	.6153
R2A5	127	1.0	5.0	2.882	.8874
R2B1	127	1.0	5.0	2.827	.8076
R2B2	127	2.0	5.0	4.323	.7441
R2B3	127	1.0	5.0	2.638	.8420
R2B4	127	1.0	5.0	2.843	1.0191
R2B5	127	1.0	5.0	2.992	.7715
R2B6	127	1.0	5.0	3.039	.9545
R2B7	127	1.0	5.0	3.228	.9935
R2C1	127	1.0	5.0	2.307	.8406
R2C2	127	1.0	4.0	1.937	.7099
R2C3	127	1.0	4.0	2.299	.5952
R2C4	127	1.0	4.0	2.535	.6274
R2C5	127	2.0	5.0	3.953	.9416
R2D1	127	3.0	5.0	4.063	.7210
R2D2	127	3.0	5.0	3.850	.7024
R2D3	127	3.0	5.0	3.646	.6240
R2D4	127	3.0	5.0	4.016	.7558
R2D5	127	1.0	4.0	2.339	.6926
R2E1	127	1.0	5.0	2.512	.9417
R2E2	127	3.0	5.0	4.244	.7206
R2E3	127	2.0	5.0	4.354	.6610
R2E4	127	1.0	4.0	2.441	.6744
R2E5	127	1.0	5.0	3.197	1.0986
R2E6	127	2.0	5.0	3.827	.8174
R2E7	127	2.0	5.0	3.929	.8374
Valid N (listwise)	127				

4.2.2.1 The 1st round of MANOVA for research objective 2

The first round of MANOVA for research objective 2 aims to assess the impact of transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year) on the difference of motivations of the shipping firms to deliver ship-generated garbage at the garbage reception facility of LCP.

4.2.2.1.1 Assumption testing of the 1st round of MANOVA

The multivariate normal distribution of dependent variables ($\underline{Y}$~N) was tested by using the Mahalanobis distance, which was calculated through linear regression analysis (Pallant, 2002). The maximum value of Mahalanobis distance (max=40.785) is higher than the critical values of chi-square (critical value=36.415). Based on this evidence, it can be concluded that there are multivariate outliers and the multivariate normal distribution assumption is not satisfied. The linear relationship among dependent variables was investigated by using scatterplots between pairs of dependent variables. Corresponding with the scatterplots, it is explored that the relationship among dependent variables is not linear implying that this assumption is

violated. Kaiser- Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were used to test the level of relationship among dependent variables. The value of Kaiser-Meyer-Olkin (KMO) is .703, which is less than .8, indicating a moderate association among dependent variables, while the Bartlett's Test of Sphericity (χ^2=1175.595, p<.000) shows the statistical significance at α=5%. This ensures the existence of the relationship among dependent variables. To further investigate the level of relationship among dependent variables, the VIF and Pearson Correlation were computed through linear regression analysis. Corresponding with the test, the value of VIF is less than 10, which can be concluded that the relationship among dependent variables is not high and the multicollinearity does not exist. Likewise, the value of Pearson Correlation is less than .8 implying that the relationship among dependent variables is not strong. The Box's Test was adopted to test Homogeneity of variance-covariance matrices of $\underline{Y}$. According to the test, the value of Box's Test (Box's M=655.135, F=1.392, p<.000) is very high and the statistical significance at α=5% is found from the test. These results indicate that the observed covariance matrices of the dependent variables are not equal across groups. Thereinafter, the error variance of an individual dependent variable was tested by using Levene's Test. The Levene's test of most attributions indicates the statistical significance at α=5%, except those of attributions R2A5, R2B3, R2C4, R2E1, R2E4, R2E5, R2E6 and R2E7, which indicate statistically insignificant at α=1% and attributions R2D2 and R2D4 that are statistically significant at α=5%. This means that the error variance of these 10 dependent variable is not equal across groups. To remedy this violation, the level of significance for testing statistical significance of the attributions R2A5, R2B3, R2C4, R2E1, R2E4, R2E5, R2E6, R2E7, R2D2 and R2D4 was set more strictly at α=1%, while that of the rest attributions was α=5%.

4.2.2.1.2 Results of the 1st round MANOVA

The next step of MANOVA analysis is to choose the right statistics for testing the overall effect of independent variable on the difference of dependent variables. As discussed in 4.2.2.1.1, the normality and multicollinearity assumptions are not held, while the multivariate outlier is found. Besides, the linearity, the homogeneity of variance-covariance matrices and the equality of variance of a particular variable assumptions are violated, except multicollinearity postulate. Based on these test results, Pillai's Trace deserves to be selected due to the fact that Wilks' Lambda is the most efficient when normality and homogeneity of variance-covariance matrices assumption are not violated, while Hotelling's Trace will be outstanding when the non-normality distribution is explored among dependent variables. Apart from other statistics, Roy's Largest Root adds a special postulate on the linear relationship of dependent variables, which is broken in this study. Therefore, the statistics of Pillai's Trace is adopted. In accordance with the test, all statistics (p<.000), including Pillai's Trace, are statistically significant at α=.05 indicating that the independent variable (level of transactional collaborations or high, moderate and low frequency of ships berthing at LCP per year) has an effect on the difference of scores (motivation score) between groups of the shipping firms at least one dependent variables. To further analyze this effect, F–test was computed for testing the effect of independent variable on a particular dependent variable. Corresponding with the test, the independent variable has an effect on the difference of score of 12 attributions including R2A1,

R2A3, R2A5, R2B1, R2B2, R2B3, R2B5, R2B7, R2C1, R2C4, R2D2, R2D3, R2E1, R2E2, R2E5, R2E6 and R2E7, because they indicate statistical significance at α=1%. Contrarily, the rest attributions comprising of R2A4 (p=.267), R2C2 (p=.327), R2C5 (p=.458), R2D1 (p=.111), R2D4 (p=.111), R2E3 (p=.544) and R2E4 (p=.162) seems not to be affected by the independent variable as their p scores are not significant at α=1%. After that, the effect of independent variable was further analyzed by using parameter estimates obtained from MANOVA analysis, as presented in Table 4.7.

Table 4.7 Descriptive statistics and parameter estimates (levels of transactional collaborations)

Descriptive Statistics					Parameter Estimates					
Level of transactional collaboration		Average	Std. Deviation	n	B	Std. Error	t	Sig.	95% Confidence Interval	
									Lower Bound	Upper Bound
R2A1	Low	4.488	.6304	84	.888	.177	5.025	.000***	.538	1.238
	Moderate	4.214	.6299	28	.614	.202	3.045	.003***	.215	1.014
	High	3.600	.6325	15	0[a]					
	Total	4.323	.6887	127						
R2A3	Low	2.179	.7786	84	-.088	.197	-.447	.656	-.478	.302
	Moderate	2.821	.5480	28	.555	.225	2.465	.015**	.109	1.000
	High	2.267	.4577	15	0[a]					
	Total	2.331	.7459	127						
R2A4	Low	2.488	.6493	84	.088	.172	.512	.609	-.252	.429
	Moderate	2.679	.5480	28	.279	.196	1.419	.158	-.110	.667
	High	2.400	.5071	15	0[a]					
	Total	2.520	.6153	127						
R2A5	Low	2.833	.7736	84	.833	.220	3.781	.000***	.397	1.270
	Moderate	3.500	.9230	28	1.500	.252	5.962	.000***	1.002	1.998
	High	2.000	.5345	15	0[a]					
	Total	2.882	.8874	127						
R2B1	Low	2.679	.7471	84	.212	.206	1.028	.306	-.196	.620
	Moderate	3.464	.7927	28	.998	.235	4.241	.000***	.532	1.463
	High	2.467	.5164	15	0[a]					
	Total	2.827	.8076	127						
R2B2	Low	4.488	.7027	84	.888	.194	4.581	.000***	.504	1.272
	Moderate	4.214	.6299	28	.614	.221	2.776	.006***	.176	1.052
	High	3.600	.7368	15	0[a]					
	Total	4.323	.7441	127						
R2B3	Low	2.571	.6992	84	.705	.210	3.357	.001***	.289	1.120
	Moderate	3.250	.9670	28	1.383	.240	5.773	.000***	.909	1.858
	High	1.867	.5164	15	0[a]					
	Total	2.638	.8420	127						
R2B5	Low	2.893	.6945	84	.360	.199	1.803	.074	-.035	.754
	Moderate	3.536	.6929	28	1.002	.228	4.404	.000***	.552	1.453
	High	2.533	.8338	15	0[a]					
	Total	2.992	.7715	127						
R2B7	Low	3.036	1.0465	84	-.631	.270	-2.337	.021**	-1.165	-.096
	Moderate	3.571	.7418	28	-.095	.308	-.309	.758	-.705	.515
	High	3.667	.8165	15	0[a]					
	Total	3.228	.9935	127						
R2C1	Low	2.202	.7727	84	.402	.217	1.850	.067	-.028	.833
	Moderate	2.893	.7860	28	1.093	.248	4.402	.000***	.602	1.584
	High	1.800	.7746	15	0[a]					
	Total	2.307	.8406	127						
R2C2	Low	1.929	.6905	84	.195	.199	.982	.328	-.198	.589
	Moderate	2.071	.8133	28	.338	.227	1.490	.139	-.111	.787
	High	1.733	.5936	15	0[a]					
	Total	1.937	.7099	127						
R2C4	Low	2.679	.6240	84	.612	.166	3.678	.000***	.283	.941
	Moderate	2.357	.6215	28	.290	.190	1.530	.129	-.085	.666
	High	2.067	.2582	15	0[a]					
	Total	2.535	.6274	127						

Descriptive Statistics					Parameter Estimates					
Level of transactional collaboration		Average	Std. Deviation	n	B	Std. Error	t	Sig.	95% Confidence Interval	
									Lower Bound	Upper Bound
R2C5	Low	3.952	.8630	84	-.248	.264	-.937	.351	-.771	.276
	Moderate	3.821	1.1239	28	-.379	.302	-1.254	.212	-.976	.219
	High	4.200	1.0142	15	0[a]					
	Total	3.953	.9416	127						
R2D1	Low	4.143	.7305	84	.410	.200	2.046	.043**	.013	.806
	Moderate	4.000	.7698	28	.267	.228	1.167	.245	-.186	.719
	High	3.733	.4577	15	0[a]					
	Total	4.063	.7210	127						
R2D2	Low	3.690	.6762	84	-.176	.185	-.954	.342	-.542	.189
	Moderate	4.321	.6696	28	.455	.211	2.158	.033**	.038	.872
	High	3.867	.5164	15	0[a]					
	Total	3.850	.7024	127						
R2D3	Low	3.452	.5007	84	-.214	.153	-1.402	.163	-.517	.088
	Moderate	4.214	.6862	28	.548	.174	3.139	.002***	.202	.893
	High	3.667	.4880	15	0[a]					
	Total	3.646	.6240	127						
R2D4	Low	3.917	.8097	84	-.350	.210	-1.668	.098	-.765	.065
	Moderate	4.179	.6696	28	-.088	.239	-.368	.714	-.562	.386
	High	4.267	.4577	15	0[a]					
	Total	4.016	.7558	127						
R2E1	Low	2.286	.8002	84	.286	.222	1.284	.201	-.155	.726
	Moderate	3.464	.9222	28	1.464	.254	5.766	.000***	.962	1.967
	High	2.000	.3780	15	0[a]					
	Total	2.512	.9417	127						
R2E2	Low	4.369	.6727	84	1.036	.180	5.743	.000***	.679	1.393
	Moderate	4.357	.6215	28	1.024	.206	4.974	.000***	.616	1.431
	High	3.333	.4880	15	0[a]					
	Total	4.244	.7206	127						
R2E3	Low	4.310	.7277	84	-.090	.186	-.487	.627	-.458	.277
	Moderate	4.464	.5079	28	.064	.212	.303	.762	-.356	.484
	High	4.400	.5071	15	0[a]					
	Total	4.354	.6610	127						
R2E4	Low	2.429	.7491	84	.229	.188	1.217	.226	-.143	.600
	Moderate	2.607	.4973	28	.407	.214	1.899	.060	-.017	.831
	High	2.200	.4140	15	0[a]					
	Total	2.441	.6744	127						
R2E5	Low	2.798	1.0388	84	-1.069	.267	-4.008	.000***	-1.597	-.541
	Moderate	4.036	.8381	28	.169	.304	.555	.580	-.434	.772
	High	3.867	.5164	15	0[a]					
	Total	3.197	1.0986	127						
R2E6	Low	3.560	.7501	84	-.174	.191	-.909	.365	-.552	.205
	Moderate	4.679	.4756	28	.945	.218	4.329	.000***	.513	1.377
	High	3.733	.5936	15	0[a]					
	Total	3.827	.8174	127						
R2E7	Low	3.679	.8665	84	-.655	.215	-3.052	.003***	-1.079	-.230
	Moderate	4.464	.5079	28	.131	.245	.535	.594	-.354	.616
	High	4.333	.4880	15	0[a]					
	Total	3.929	.8374	127						

Remark [a] The base group.
, * Statistically significant at the .05 level and .01 level.

In accordance with Table 4.7, the attributions R2A1, R2A5, R2B2, R2B3 and R2E2 have an effect on the difference of score between both comparing groups - the Low and the Moderate - and the base group – the High group. Contrarily, the attribution R2B7, R2C4, R2D1, R2E5 and R2E7 have an effect on the distinction of the score between the Low group and the High group, while the attributions R2A3, R2B1, R2B5, R2C1, R2D2, R2D3, R2E1 and R2E6 indicate the effect on the difference of the score between the Moderate group and the High group. Afterwards, the difference of score between the Low and the Moderate Groups was

further analyzed by using post hoc test. The equal variance is not assumed in the post hoc test as the results of Box's Test and Levene's Test obviously indicate the violation of these assumptions. With this reason, the post hoc test is based on the Games-Howell test, of which the inequality of variance is assumed. The result of post hoc test is presented in Table 4.8.

Table 4.8 Post hoc test between Low and Moderate groups (levels of transactional collaborations)

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
R2A1	Low	Moderate	.274	.1375	.126	-.059	.607
R2A3	Low	Moderate	-.643	.1339	.000***	-.964	-.322
R2A4	Low	Moderate	-.190	.1255	.291	-.493	.112
R2A5	Low	Moderate	-.667	.1938	.004***	-1.138	-.195
R2B1	Low	Moderate	-.786	.1705	.000***	-1.199	-.372
R2B2	Low	Moderate	.274	.1416	.140	-.068	.616
R2B3	Low	Moderate	-.679	.1980	.004***	-1.162	-.195
R2B5	Low	Moderate	-.643	.1513	.000***	-1.009	-.277
R2B7	Low	Moderate	-.536	.1808	.012**	-.969	-.102
R2C1	Low	Moderate	-.690	.1708	.001***	-1.104	-.277
R2C2	Low	Moderate	-.143	.1712	.684	-.559	.273
R2C4	Low	Moderate	.321	.1358	.056	-.007	.650
R2C5	Low	Moderate	.131	.2323	.840	-.436	.697
R2D1	Low	Moderate	.143	.1659	.667	-.259	.545
R2D2	Low	Moderate	-.631	.1465	.000***	-.986	-.276
R2D3	Low	Moderate	-.762	.1407	.000***	-1.105	-.418
R2D4	Low	Moderate	-.262	.1543	.215	-.634	.110
R2E1	Low	Moderate	-1.179	.1949	.000***	-1.652	-.705
R2E2	Low	Moderate	.012	.1385	.996	-.323	.346
R2E3	Low	Moderate	-.155	.1246	.433	-.453	.144
R2E4	Low	Moderate	-.179	.1246	.329	-.477	.120
R2E5	Low	Moderate	-1.238	.1948	.000***	-1.707	-.769
R2E6	Low	Moderate	-1.119	.1216	.000***	-1.410	-.828
R2E7	Low	Moderate	-.786	.1347	.000***	-1.107	-.464

Remark **, *** Statistically significant at the .05 level and .01 level respectively.

According to Table 4.8, 13 attributions out of 24 attributions indicate the statistical significance at α=5% and 1% implying that their score between the Low and the Moderate Groups is statistically different. These attributions are R2A3, R2A5, R2B1, R2B3, R2B5, R2B7, R2C1, R2D2, R2D3, R2E1, R2E5, R2E6 and R2E7. In contrast, the rest attributions, including R2A1, R2A4, R2B2, R2C2, R2C4, R2C5, R2D1, R2D4, R2E2, R2E3 and R2E4, are not significant at the required level of significance indicating that their score is not different.

4.2.2.2 The 2nd round of MANOVA for research objective 2

The second round of MANOVA aims to assess the impact of the nationality of the shipping firms on the difference of motivations to deliver ship-generated garbage at the garbage reception facility of LCP.

4.2.2.2.1 Assumption testing of the 2nd round of MANOVA

The maximum value of Mahalanobis distance (max=40.785) obtained from linear regression is higher than the critical values of chi-square (critical value=36.415). Based on this result, it can be concluded that there is multivariate outliers and the multivariate normal distribution assumption is not satisfied. The

scatterplots between pairs of dependent variables were used to test the linearity assumption. It is found that the relationship among dependent variables is not linear implying that this assumption is violated. The Bartlett's Test of Sphericity (χ^2 =1175.595, p<.000), VIF (<10) and Pearson Correlation (<.8) indicate the moderate relationship and the multicollinearity problem does not exist. Box's Test was adopted to test Homogeneity of variance-covariance matrices of Y. According to the test, the value of Box's Test (Box's M=587.310, F=1.198, p<.012) is relatively high and the statistical significance at α=5% is found from the test. These results indicate that the observed covariance matrices of the dependent variables are not equal across groups. Thereinafter, the error variance of an individual dependent variable was tested by using Levene's Test. In accordance with the results, the Levene's test of most attributions indicates the statistical insignificance at α=5%, except those of attribution R2E1, R2E4 and R2E7, which indicate statistically insignificant at α=1% and the attribution R2E3 that is statistically significant at α=5%. This implies that the error variance of these 4 dependent variables is not equal across the groups. To remedy this violation, the level of significance for testing statistical significance of the attribution R2E1 R2E3, R2E4 and R2E7 was set more strictly at α=1%, while those of the rest attributions were set at α=5%.

4.2.2.2.2 Result of the 2nd round MANOVA

The next step is to select the right statistics to examine the overall effect of independent variable on the difference of dependent variables. As discussed in 4.2.2.2.1, all assumptions of MANOVA are not held except multicollinearity assumption implying that Pillai's Trace would outperform in this situation. The statistics of Pillai's Trace is adopted. Based on the result, Pillai's Trace (p=.332) indicates statistical insignificance at α=5% meaning that the independent variable (firms' nationality) has no effect on the distinction of the motivation score. To further analyze the effect of independent variable, F-test was generated for examining if the independent variable affect the score of each attribution or not. Corresponding with the test, all attributions indicate statistical insignificance at α=.05 (p>.05) meaning that the independent variable has no impact on the difference of score of all attributions. After that, the impact of independent variable was further analyzed by using parameter estimates obtained from MANOVA analysis, as presented in Table 4.9.

Table 4.9 Descriptive statistics and parameter estimates (nationality of firm)

Descriptive Statistics					Parameter Estimates					
Nationality		Average	Std. Deviation	n	B	Std. Error	t	Sig.	95% Confidence Interval	
									Lower Bound	Upper Bound
R2A1	Foreign	4.267	.6617	101	-.271	.150	-1.806	.073	-.568	.026
	Thai	4.538	.7606	26	0[a]					
	Total	4.323	.6887	127						
R2A3	Foreign	2.356	.7428	101	.126	.164	.765	.446	-.200	.451
	Thai	2.231	.7646	26	0[a]					
	Total	2.331	.7459	127						
R2A4	Foreign	2.525	.6098	101	.025	.136	.182	.856	-.244	.294
	Thai	2.500	.6481	26	0[a]					
	Total	2.520	.6153	127						
R2A5	Foreign	2.871	.9237	101	-.052	.196	-.264	.792	-.439	.336
	Thai	2.923	.7442	26	0[a]					
	Total	2.882	.8874	127						

Descriptive Statistics					Parameter Estimates					
Nationality		Average	Std. Deviation	n	B	Std. Error	t	Sig.	95% Confidence Interval	
									Lower Bound	Upper Bound
R2B1	Foreign	2.881	.8401	101	.266	.177	1.504	.135	-.084	.616
	Thai	2.615	.6373	26	0[a]					
	Total	2.827	.8076	127						
R2B2	Foreign	4.267	.7469	101	-.271	.162	-1.669	.098	-.593	.050
	Thai	4.538	.7060	26	0[a]					
	Total	4.323	.7441	127						
R2B3	Foreign	2.644	.8785	101	.028	.186	.152	.880	-.340	.396
	Thai	2.615	.6972	26	0[a]					
	Total	2.638	.8420	127						
R2B5	Foreign	3.030	.8180	101	.184	.170	1.083	.281	-.152	.519
	Thai	2.846	.5435	26	0[a]					
	Total	2.992	.7715	127						
R2B7	Foreign	3.238	.9607	101	.045	.219	.207	.837	-.389	.479
	Thai	3.192	1.1321	26	0[a]					
	Total	3.228	.9935	127						
R2C1	Foreign	2.376	.8228	101	.338	.183	1.845	.067	-.025	.700
	Thai	2.038	.8709	26	0[a]					
	Total	2.307	.8406	127						
R2C2	Foreign	1.980	.7068	101	.211	.156	1.356	.178	-.097	.519
	Thai	1.769	.7104	26	0[a]					
	Total	1.937	.7099	127						
R2C4	Foreign	2.515	.6263	101	-.101	.138	-.727	.468	-.374	.173
	Thai	2.615	.6373	26	0[a]					
	Total	2.535	.6274	127						
R2C5	Foreign	3.901	.9849	101	-.253	.207	-1.223	.223	-.662	.156
	Thai	4.154	.7317	26	0[a]					
	Total	3.953	.9416	127						
R2D1	Foreign	4.069	.7247	101	.031	.159	.194	.847	-.284	.346
	Thai	4.038	.7200	26	0[a]					
	Total	4.063	.7210	127						
R2D2	Foreign	3.861	.6787	101	.054	.155	.346	.730	-.253	.360
	Thai	3.808	.8010	26	0[a]					
	Total	3.850	.7024	127						
R2D3	Foreign	3.673	.6498	101	.135	.137	.982	.328	-.137	.406
	Thai	3.538	.5084	26	0[a]					
	Total	3.646	.6240	127						
R2D4	Foreign	4.040	.7338	101	.117	.167	.700	.485	-.213	.446
	Thai	3.923	.8449	26	0[a]					
	Total	4.016	.7558	127						
R2E1	Foreign	2.614	.9795	101	.498	.203	2.455	.015	.097	.900
	Thai	2.115	.6528	26	0[a]					
	Total	2.512	.9417	127						
R2E2	Foreign	4.238	.7092	101	-.032	.159	-.199	.843	-.346	.283
	Thai	4.269	.7776	26	0[a]					
	Total	4.244	.7206	127						
R2E3	Foreign	4.356	.6258	101	.010	.146	.070	.944	-.279	.299
	Thai	4.346	.7971	26	0[a]					
	Total	4.354	.6610	127						
R2E4	Foreign	2.455	.6087	101	.071	.149	.476	.635	-.224	.365
	Thai	2.385	.8979	26	0[a]					
	Total	2.441	.6744	127						
R2E5	Foreign	3.238	1.0784	101	.199	.242	.823	.412	-.280	.678
	Thai	3.038	1.1826	26	0[a]					
	Total	3.197	1.0986	127						
R2E6	Foreign	3.891	.8112	101	.314	.178	1.762	.080	-.039	.667
	Thai	3.577	.8086	26	0[a]					
	Total	3.827	.8174	127						
R2E7	Foreign	3.980	.7743	101	.249	.184	1.359	.177	-.114	.613
	Thai	3.731	1.0414	26	0[a]					
	Total	3.929	.8374	127						

Remark [a] The base group.

In accordance with Table 4.9, the parameter estimates of attributions R2E1, R2E3, R2E4 and R2E7 indicate no statistical insignificance at α=1%, whereas the rest attributions show statistical insignificance at α=5%. This means that the independent variable does not have an effect on the difference of the evaluated score between the foreign and Thai shipping groups.

4.2.2.3 The 3rd round of MANOVA for research objective 2

The third round of MANOVA aims to assess the impact of the nationality of the shipping firms on the difference of motivations to deliver ship-generated garbage at the garbage reception facility of LCP.

4.2.2.3.1 Assumption testing of the 3rd round of MANOVA

The maximum value of Mahalanobis distance (max=40.785) obtained from linear regression is higher than the critical values of chi-square (critical value=36.415). It can be concluded that there is multivariate outliers and the multivariate normal distribution assumption is not satisfied. The scatterplots between pairs of dependent variables were used to test the linearity assumption. It is explored that the relationship among dependent variables is not linear implying that this assumption of MANOVA is violated. The Bartlett's Test of Sphericity (χ^2 =1175.595, p<.000), VIF (<10) and Pearson Correlation (<.8) indicate that the moderate relationship is found among the dependent variables and multicollinearity problem does not exist. Box's Test was adopted to test Homogeneity of variance-covariance matrices of Y. According to the test, the value of Box's Test (Box's M=1218.125, F=1.232, p<.000) is high and the statistical significance at α=5% is found from the test. These results indicate that the observed covariance matrices of the dependent variables are not equal across groups. Thereinafter, the error variance of an individual dependent variable was tested by using Levene's Test. In accordance with the results, the value of Levene's test of most attributions is statistical insignificant at α=5% except those of attributions R2C5, R2D4 and R2E3, which indicate statistical insignificance at α=1% and the attributions R2B5, R2B7, R2C1, R2D3 and R2E4 that are statistically significant at α=5%. This implies that the error variance of these 8 dependent variable is not equal across groups. To remedy this violation, the level of significance for testing statistical significance of these 8 attributions was set more strictly at α=1%, while those of the rest attributions were set at α=5%.

4.2.2.3.2 Result of the 3rd round MANOVA

Next step is to select the appropriate statistics for testing the overall effect of the independent variable on the difference of the performance score. According to the hypothesis testing, all assumptions are violated except multicollinearity assumption indicating that the statistics of Pillai's Trace should be opted for statistics test. In accordance with the test, Pillai's Trace (p=.197) is statistically insignificant at α=5% indicating that the independent variable (types of ship) has no effect on the difference of scores (motivation) between comparing groups and the base group. To further analyze the effect of independent variable, F–test was used. In

accordance with the outcomes, the independent variable has an effect on the difference of score of 9 attributions comprising of R2C5, R2D2, R2D3, R2D4 and R2E2 which indicate statistical significance at α=1% and R2A3, R2A4, R2B2 and R2E7, which are statistically significant at α=5%. This implies that they are affected by the independent variable. Contrarily, the rest attributions are insignificant either at α=5% and 1% indicating that they are not influenced by the independent variable.

After that, the effect of independent variable was further analyzed by using parameter estimates and post hoc test. Corresponding with the result of parameter estimates, the independent variable has an effect on the difference of the score between the group of general cargo ship and the base group in attributions R2A3, R2B2 and R2D2, while the score between the Vehicles Carrier/RoRo and the base group in attributions R2A4 and R2C5 seem to be affected by the independent variable. In accordance with the result of post hoc test, the attribution R2A1 indicates the difference of the score between 3 pairs – 1) general cargo and container ship, 2) general cargo and vehicles carrier/RoRo and 3) bulk carrier and vehicles carrier/RoRo while the attribution R2A3, R2C1 and R2E4 present the distinction in the score between 1) general cargo and vehicles carrier/RoRo as well as 2) container ship and vehicles carrier/RoRo. The attribution R2B1 shows that difference in the score of between general cargo and vehicles carrier/RoRo. The attributions R2B2 and R2D2 indicate that distinction between 1) general cargo and container ship, 2) general cargo and vehicles carrier/RoRo. The attribution R2B5 indicates the dissimilarity of the score of all pairs except among general cargo and container ship and bulk carrier. The attribution R2C5 demonstrates the uncommon score between 1) general cargo and vehicles carrier/RoRo, 2) container ship and vehicles carrier/RoRo and 3) bulk carrier and vehicles carrier/RoRo while the attribution R2D3 illustrates the difference between 1) general cargo and vehicles carrier/RoRo, 2) bulk carrier and vehicles carrier/RoRo and 3) container ship and bulk carrier. The attribution R2E2 demonstrates the uncommon score between general cargo and container ship, while the attribution R2E3 indicates the distinction between container ship and vehicles carrier/RoRo.

4.2.3 Data analysis for research objective 3

4.2.3.1 Transactional and Cooperative collaborations

This section explains how ordinal regression was adopted to analyze the relationship between transactional collaborations (independent variable) and cooperative collaborations (dependent variable).

4.2.3.1.1 Hypothesis testing

The postulates of ordinal regression are tested. Firstly, the model fitting information of all cases demonstrates a very high likelihood ratio test (-2 log-likelihood) and statistical significance at α=5%. This indicates that the final model with all the explanatory variables (R3A1-R3A7) fits well with the data than the model without any explanatory variables. The goodness of fit ($p>.05$) shows insignificance at α=5% implying the consistence between the fit of model and the observed data in all cases. Pseudo R-square (ranging between .38 - .43) illustrates that the transactional collaborations can moderately explain the change of cooperative collaborations (R3B1-R3B8). The test of parallel line, which investigates that whether the slope coefficients

are the same across response categories, indicates statistical insignificance at α=5% (p>.05) meaning that the ordinal regression is appropriate for analyzing the relationship between transactional and cooperative collaborations.

4.2.3.1.2 Effect of independent variable

The influence of independent variables (R3A1-R3A7) on the dependent variables (R3B1-R3B8) is investigated by using parameter estimates. The attributions R3A1 and R3A7 have a positive effect on R3B8 and R3B3 respectively thanks to their positive coefficients. Nevertheless, they seem not to be the potential factor as they have a scarce impact on cooperative attributions. In contrast, the positive and negative effects are explored between the transactional attributions R3A2, R3A3, R3A4, R3A5 and R3A6 and the cooperative attributions due to the positive and negative coefficients of the variables. The attributions R3A3 and R3A6 seem to be the powerful factors as they affect a number of cooperative attributions, while the attribution R3B1-R3B3 seem to be the most sensitive attribution as they are heavily affected by most transactional attributions.

4.2.3.2 Transactional and Coordinated collaborations

This section explains how ordinal regression was adopted to analyze the relationship between transactional collaborations (independent variable) and coordinated collaborations (dependent variable).

4.2.3.2.1 Hypothesis testing

Firstly, the model fitting information of all cases shows a high likelihood ratio test with statistical significance at α=5% (p<.000). This means that the final model with all the explanatory variables (R3A1-R3A7) fits well with the data rather than the model without any explanatory variables. This result is confirmed by the goodness of fit (Deviance statistics), which presents insignificance at α=5% (p>.05) meaning that the consistence between the fit of model and the observed data in all cases is ensured. Pseudo R-square Statistics (ranging between .354 - .496) illustrate that the transactional collaborations can moderately explain the variation of coordinated collaborations (R3C1-R3C8). Ultimately, the test of parallel line indicates statistical insignificance at α=5% (p>.05) implying that the slope coefficients are similar across the response categories. Corresponding with this results, it means that the ordinal regression is reasonable for analyzing the relationship between transactional and coordinated collaborations.

4.2.3.2.2 Effect of independent variable

The influence of independent variables (R3A1-R3A7) on the dependent variables (R3C1-R3C8) is investigated by using parameter estimates at α=5%. Firstly, the attribution R3A1 has a positive effect on the attribution R3C3, R3C4, R3C7 and R3C8 because of its positive coefficient. Likewise, the attributions R3A4 and R3A7 also provide the positive relationship with the coordinated attributions. The

attribution R3A5 indicates that it has a negative association with the coordinated attribution R3C3 and R3C7 while the attributions R3A2, R3A3 and R3A6 have both positive and negative effects on the coordinated attributions. The R3A5 seem to be the least powerful attribution as it has a small effect on the coordinated collaborations while the rest transactional attributions have a huge effect on the coordinated collaborations.

4.2.3.3 Transactional and Synchronized collaborations

This section explains how ordinal regression was adopted to analyze the relationship between transactional collaborations (independent variables) and coordinated collaborations (dependent variables).

4.2.3.3.1 Hypothesis testing

The model fitting information shows a high likelihood ratio test and statistical significance at α=5% ($p<.000$) meaning that the final model with all the explanatory variables (R3A1-R3A7) fits well with the data rather than the model without any explanatory variables. This conclusion is further confirmed by the Deviance statistics which presents insignificance at α=5% ($p>.05$) implying that the goodness of fit is maintained. Pseudo R-square Statistics (ranging between .461 - .572) outline that the transactional collaborations can moderately explain the variation of synchronized collaborations (R3D1-R3D8). The test of parallel line in every case indicates statistical insignificance at α=5% ($p>.05$) implying that the slope coefficients are similar across the response categories. In accordance with these results, it can be concluded that the ordinal regression is reasonable for analyzing the relationship between transactional and synchronized collaborations.

4.2.3.3.2 Effect of independent variables

The effect of independent variables (R3A1-R3A7) on the dependent variables (R3D1-R3D8) is investigated by using parameter estimates at α=5%. All in all, the attributions R3A1 and R3A4 have a positive impact on the attributions A3D1 and R3D2 due to the positive coefficients, while the attribution R3A7 has the same effect on R3D1-R3D3. Contrarily, the attribution R3A2 has a negative consequence on both R3D2 and R3D3 owning to the negative coefficient, while the rest transactional attributions, including R3A3, R3A5 and R3A6, illustrate a positive effect on the synchronized attributions, except a few attributions negatively dominated by them. Obviously, the attributions R3A3 and R3A6 have an effect on most synchronized attributions, whereas the rest transactional collaborations have a small-scale impact on the synchronized collaborations.

4.2.3.4 Cooperative and Coordinated collaborations

This section explains how ordinal regression was adopted to analyze the relationship between cooperative collaborations (independent variables) and coordinated collaborations (dependent variables).

4.2.3.4.1 Hypothesis testing

The model fitting information of all cases illustrates a high likelihood ratio test and statistical significance at α=5% (p<.000) meaning that the final model with all the explanatory variables (R3B1-R3B8) considerably fits with the data rather than the model without any explanatory variables. Besides, the goodness of fit presents the statistical insignificance at α=5% (p>.05) meaning that the consistence between the fit of model and the observed data in all cases is ensured. Pseudo R-square (ranging between .369-.591) illustrates that the cooperative collaborations can moderately to highly explain the variation of coordinated collaborations (R3C1-R3C8). Ultimately, the test of parallel line indicates statistical insignificance at α=5% (p>.05) implying that the slope coefficients are similar across the response categories. This means that the ordinal regression is reasonable for analyzing the relationship between cooperative and coordinated collaborations.

4.2.3.4.2 Effect of independent variable

The influence of independent variables (R3B1-R3B8) on the dependent variables (R3C1-R3C8) is assessed by using parameter estimates at α=5%. In summary, the attribution R3B3 seems to be the most powerful factor generating a negative impact to all coordinated attributions. The negative impact is also found between the R3B1 and R3C7, between R3B4 and R3C7, and between R3B6 and R3C1 and R3C4. In contrast, the attribution R3B5 presents the positive impact on the attribution R3C4 due to the non-negative coefficient, whereas the rest of the attributions, including R3B2, R3B7 and R3B8, indicate the positive and negative effects on the coordinated attributions. The attributions R3B1, R3B4 and R3B5 have a small effect on the coordinated collaborations in comparison with the rest cooperative attributions. The attributions R3C4 and R3C7 seem to be the most sensitive attribution compared with the remaining synchronized attributions as they are considerably affected by most cooperative attributions.

4.2.3.5 Cooperative and Synchronized collaborations

This section explains how ordinal regression was adopted to analyze the relationship between cooperative collaborations (independent variables) and synchronized collaborations (dependent variables).

4.2.3.5.1 Hypothesis testing

The model fitting information of all cases illustrates a high likelihood ratio test and statistical significance at α=5% (p<.000) meaning that the final model with all the explanatory variables (R3B1-R3B8) substantially fits with the data rather than the model without any explanatory variables. The Deviance statistics shows statistical insignificance at α=5% (p>.05) indicating that the consistence between the fit of model and the observed data in all cases is maintained. Pseudo R-square (ranging between .482 - .645) illustrates that the cooperative collaborations can moderately-highly explain the variation of synchronized collaborations (R3D1-R3D8). The test of

parallel line indicates statistical insignificance at α=5% (p>.05) implying that the slope coefficients are similar across the response categories. Corresponding this result, it means that the ordinal regression is reasonable for analyzing the relationship between cooperative and synchronized collaborations.

4.2.3.5.2 Effect of independent variables

The influence of independent variables (R3B1-R3B8) on the dependent variables (R3D1-R3D8) is assessed by using parameter estimates at α=5%. In summary, the attribution R3B3 generates a negative consequence on the attributions R3D1-R3D6, while the attribution R3B1 indicates the positive effect on the odds ratio of R3D3. The rest cooperative attributions indicate the mixed effects on the synchronized attributions. The attributions R3B2 as well as R3B7 illustrate the common influence on the synchronized attributions R3D2-R3D5. On the one hand, the attributions R3D2, R3D3 and R3D4 are positively dominated by them; on the other hands, the attribution R3D5 is negatively affected by them. Similarly, the positive and negative effects are also found from attributions R3B4, R3B5, R3B6 and R3B8 on the synchronized attributions. R3B5 seems to be the least powerful factor as it has a small effect on the synchronized collaborations in comparison with the other three attributions. The attributions R3D2-R3D5 are the most sensitive factor as they substantially dominated by the cooperative attributions.

4.2.3.6 Coordinated and Synchronized collaborations

This section explains how ordinal regression was adopted to analyze the relationship between coordinated collaborations (independent variables) and synchronized collaborations (dependent variables).

4.2.3.6.1 Hypothesis testing

The model fitting information of all cases illustrates a high likelihood ratio test and statistical significance at α=5% (p<.000) implying that the final model with all the explanatory variables (R3C1-R3C8) fits with the data rather than the model without any explanatory variables. The Deviance statistics shows statistical insignificance at α=5% (p>.05) meaning that the consistence between the fit of model and the observed data in all cases is maintained. Pseudo R-square (ranging between .569-.881) illustrates that the cooperative collaborations can relatively highly explain the variation of synchronized collaborations (R3D1-R3D8). The parallel line test indicates the statistical insignificance at α=5% (p>.05) implying that the ordinal regression is reasonable for analyzing the relationship between coordinated and synchronized collaborations.

4.2.3.6.2 Effect of independent variables

After all assumptions of ordinal regression were tested, the influence of independent variables (R3C1-R3C8) on the dependent variables (R3D1-R3D8) is tested by using parameter estimates at α=5%. Generally, the parameter

estimates are the logit (log odds ratio) of such the variable. The statistical significance of coefficients ($p<.05$) means that such the variable has an effect on the dependent variable. The positive sign (+) indicates the increase of odds ratio (OR) in comparison with the base group; conversely, the negative emblem demonstrates the decrease of OR compared with the base group. Corresponding with the test results, the attributions R3C2, R3C4, R3C6 and R3C8 have both positive and negative effects on the synchronized attributions. The attributions R3C2 and R3C6 indicate a small effect on the synchronized collaborations in comparison with the attributions R3C4 and R3C8 which have a huge impact. Conversely, the rest of the coordinated attributions, including R3C1, R3C3, R3C5 and R3C7 indicate a negative effect on the synchronized attributions due to the minus coefficients. The attributions R3C1 and R3C3 indicate a small negative impact on the synchronized collaborations while the attribution R3C5 and R3C7 demonstrate a large negative effect on a number of synchronized attributions.

4.2.4 Data analysis for research objective 4

There are 14 attributions in the dataset including R3A3, R3A4, R3A7, R3B2, R3B3, R3B5, R3B8, R3C4, R3C6, R3C8, R3D3, R3D5, R3D7 and R3D8. The descriptive statistics of each attribution are shown in Table 4.10.

Table 4.10 Descriptive statistics of the attributions from questionnaire part 4

Attribution	n	Minimum	Maximum	Average	Std. Deviation
R3A3	127	2.0	5.0	3.756	1.0057
R3A4	127	2.0	5.0	3.559	.9228
R3A7	127	3.0	5.0	4.276	.6130
R3B2	127	2.0	5.0	3.346	.7805
R3B3	127	1.0	5.0	2.937	.8796
R3B5	127	3.0	5.0	4.417	.6719
R3B8	127	2.0	5.0	4.291	.7675
R3C4	127	1.0	5.0	3.110	1.0483
R3C6	127	1.0	5.0	3.047	.9583
R3C8	127	2.0	5.0	3.717	.9751
R3D3	127	1.0	5.0	3.244	1.1249
R3D5	127	2.0	5.0	3.732	.8949
R3D7	127	1.0	5.0	3.787	1.2060
R3D8	127	2.0	5.0	4.331	.8914
Valid N (listwise)	127				

4.2.4.1 The 1st round of MANOVA for research objective 4

The first round of MANOVA aims to assess the impact of the levels of transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year) on the difference of benefits generated from shipping collaborations between the shipping firms and LCP in ship-generated garbage management.

4.2.4.1.1 Assumption testing of the 1st round MANOVA

The multivariate normal distribution of dependent variables (Y~N) is tested by using the Mahalanobis distance, which was calculated through linear regression analysis. The test result indicates that the maximum value of Mahalanobis distance (25.190) is greater than the critical values (23.685). It can be summarized that there is multivariate outliers and the multivariate normal distribution is violated. The

linear association among dependent variables was investigated by using scatterplots between pairs of dependent variables. Corresponding with the scatterplots, it is found that the relationship among dependent variables is not linear implying that this assumption is violated. After that, the assumption of moderate relationship among dependent variables was tested by using Kaiser- Meyer-Olkin (KMO) and Bartlett's Test of Sphericity. According to the test, the value of KMO is .69 while the Bartlett's Test of Sphericity (χ^2=503.69, p<.000) shows statistical significance at α=5%. These results indicate the existence of the moderate relationship among dependent variables. The results of VIF and Pearson Correlation indicate that VIF is less than 10 while the Pearson Correlation is less than .8. These results imply that the relationship among dependent variables is not strong and the multicollinearity assumption is not violated. Box's Test was adopted to test Homogeneity of variance-covariance matrices of $\underline{Y}$ for group i ; i=1, 2,..,k ($\Sigma_1 = \Sigma_2 = \ldots \Sigma_k$). According to the test, the value of Box's Test (Box's M =509.240, F=1.672, p<.000) is very high and the statistical significance at α=5% is found from the test. This result indicates that the observed covariance matrices of the dependent variables are not equal across groups. Thereinafter, the error variance of an individual dependent variable was tested by using Levene's Test. Corresponding with the results, the value of Levene's test of the attribution R3A3 (p=.002), R3A7 (p<.000), R3B5 (p=.002), R3C8 (p<.000), R3D3 (p=.002), R3D5 (p<.000) and R3D7 (p<.000) is statistically significant at α=1% and those of attributions R3B8 and R3C4, which indicate statistical significance at α=5%. This means that they violate this postulate while the attributions R3A4 (p=.282), R3B2 (p=.114), R3B3 (p=.088), R3C6 (p=.164) and R3D8 (p=.719) are statistically insignificant at α=5% meaning that they hold this assumption. To remedy the violation of this assumption, the level of significance for testing statistical significance of the above 9 significant attributions was set more strictly at α=1% while that of the rest attributions was α=5%.

4.2.4.1.2 Result of the 1st round of MANOVA analysis

Next step of MANOVA analysis is to pick up the suitable statistics for testing the overall effect of independent variables on the difference of dependent variables. As discussed in 4.2.4.1.1, the normality assumption as well as the multivariate outlier are not held. Furthermore, the linearity, homogeneity of variance-covariance matrices and equality of variance of a particular variable are violated. Based on these evidences, Pillai's Trace deserves to be selected. In accordance with the test, Pillai's Trace is statistically significant at α=.05 (p<.000) indicating that the independent variable has an effect on the difference of scores at least one dependent variables. To further analyze this effect, F–test was used to test the effect of independent variables on a particular dependent variable. Corresponding with the outcomes, the independent variables seem to have an effect on the difference of the score of all attributions because they indicate statistical significance at α=1%. Contrarily, only 2 attributions - R3B5 and R3D7 - are not affected by the independent variable as they are statistically insignificant at α=1% and 5% respectively. After that, the effect of independent variables was further analyzed by using parameter estimates presented in Table 4.11.

Table 4.11 Descriptive statistics and parameter estimates (levels of transactional collaborations)

Descriptive Statistics					Parameter Estimates					
Level of transactional collaboration		Average	SD	n	B	Std. Error	t	Sig.	95% Confidence Interval	
									Lower Bound	Upper Bound
R3A3	Low	4.179	.8665	84	1.979	.212	9.340	.000***	1.559	2.398
	Moderate	3.321	.4756	28	1.121	.242	4.637	.000***	.643	1.600
	High	2.200	.4140	15	0[a]					
	Total	3.756	1.0057	127						
R3A4	Low	3.917	.8245	84	1.117	.219	5.106	.000***	.684	1.550
	Moderate	2.893	.6853	28	.093	.250	.372	.711	-.401	.587
	High	2.800	.6761	15	0[a]					
	Total	3.559	.9228	127						
R3A7	Low	4.440	.5881	84	.374	.160	2.339	.021	.057	.690
	Moderate	3.893	.5669	28	-.174	.182	-.953	.343	-.535	.187
	High	4.067	.4577	15	0[a]					
	Total	4.276	.6130	127						
R3B2	Low	3.571	.7162	84	1.171	.192	6.096	.000***	.791	1.552
	Moderate	3.179	.6696	28	.779	.219	3.549	.001***	.344	1.213
	High	2.400	.5071	15	0[a]					
	Total	3.346	.7805	127						
R3B3	Low	2.702	.6727	84	.502	.180	2.797	.006***	.147	.858
	Moderate	4.036	.6372	28	1.836	.205	8.953	.000***	1.430	2.242
	High	2.200	.4140	15	0[a]					
	Total	2.937	.8796	127						
R3B5	Low	4.429	.7162	84	.362	.186	1.950	.053	-.005	.729
	Moderate	4.571	.5040	28	.505	.212	2.383	.019	.085	.924
	High	4.067	.5936	15	0[a]					
	Total	4.417	.6719	127						
R3B8	Low	4.143	.8380	84	-.190	.207	-.922	.358	-.599	.218
	Moderate	4.714	.4600	28	.381	.236	1.616	.109	-.086	.848
	High	4.333	.4880	15	0[a]					
	Total	4.291	.7675	127						
R3C4	Low	2.714	.9515	84	-.952	.250	-3.813	.000***	-1.447	-.458
	Moderate	4.000	.8607	28	.333	.285	1.169	.245	-.231	.898
	High	3.667	.4880	15	0[a]					
	Total	3.110	1.0483	127						
R3C6	Low	3.083	.9843	84	.950	.250	3.793	.000***	.454	1.446
	Moderate	3.429	.7418	28	1.295	.286	4.530	.000***	.729	1.861
	High	2.133	.5164	15	0[a]					
	Total	3.047	.9583	127						
R3C8	Low	3.738	.9954	84	1.071	.247	4.338	.000***	.583	1.560
	Moderate	4.214	.6299	28	1.548	.282	5.489	.000***	.990	2.106
	High	2.667	.4880	15	0[a]					
	Total	3.717	.9751	127						
R3D3	Low	2.810	1.0583	84	-.724	.258	-2.801	.006***	-1.235	-.212
	Moderate	4.393	.5669	28	.860	.295	2.914	.004***	.276	1.443
	High	3.533	.5164	15	0[a]					
	Total	3.244	1.1249	127						
R3D5	Low	3.571	.8820	84	.505	.214	2.357	.020	.081	.929
	Moderate	4.571	.5040	28	1.505	.244	6.156	.000***	1.021	1.989
	High	3.067	.2582	15	0[a]					
	Total	3.732	.8949	127						
R3D7	Low	3.738	1.3981	84	.071	.339	.211	.834	-.600	.743
	Moderate	4.000	.7698	28	.333	.387	.861	.391	-.433	1.100
	High	3.667	.4880	15	0[a]					
	Total	3.787	1.2060	127						
R3D8	Low	4.619	.4885	84	2.286	.143	16.025	.000***	2.003	2.568
	Moderate	4.536	.5079	28	2.202	.163	13.527	.000***	1.880	2.525
	High	2.333	.6172	15	0[a]					
	Total	4.331	.8914	127						

Remark [a] The base group.
, * Statistically significant at the .05 level and the .01 level respectively.

In accordance with Table 4.11, the effect of independent variables on the difference of the score between the Low and the Moderate Groups (as the comparing group) and the High Group (as the base group) is found in attributions R3A3, R3B2, R3B3, R3C6, R3C8, R3D3 and R3D8 as they indicate statistical significance at α=1% while the attributions R3A4 and R3C4 present the influence of independent variables on the score between the Low and the High groups as they show the statistical significance at α=1%. Contrarily, the difference of score between the Moderate and the High groups is explored in attribution R3D5. Thereinafter, the difference of score between the Low and the Moderate Groups was analyzed by using post hoc test. The equal variance is not assumed in the post hoc test as the results of Box's Test and Levene's Test obviously indicate the violation of these assumptions. Thus, the test is based on Games-Howell test, of which the inequality of variance is assumed. The result of post hoc test is presented in Table 4.12.

Table 4.12 Post hoc test between Low and Moderate groups (levels of transactional collaborations)

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
R3A3	Low	Moderate	.857*	.1304	.000***	.546	1.168
R3A4	Low	Moderate	1.024*	.1577	.000***	.644	1.404
R3A7	Low	Moderate	.548*	.1249	.000***	.246	.850
R3B2	Low	Moderate	.393*	.1487	.029**	.033	.752
R3B3	Low	Moderate	-1.333*	.1410	.000***	-1.674	-.992
R3B5	Low	Moderate	-.143	.1232	.481	-.438	.153
R3B8	Low	Moderate	-.571*	.1262	.000***	-.872	-.271
R3C4	Low	Moderate	-1.286*	.1930	.000***	-1.752	-.820
R3C6	Low	Moderate	-.345	.1766	.132	-.769	.079
R3C8	Low	Moderate	-.476*	.1611	.012	-.862	-.091
R3D3	Low	Moderate	-1.583*	.1575	.000***	-1.959	-1.208
R3D5	Low	Moderate	-1.000*	.1354	.000***	-1.323	-.677
R3D7	Low	Moderate	-.262	.2108	.432	-.765	.241
R3D8	Low	Moderate	.083	.1098	.730	-.183	.349

Remark **, *** Statistically significant at the .05 level and the .01 level respectively.

According to Table 4.12, 8 out of 9 attributions, comprising of R3A3, R3A4, R3A7, R3B2, R3B3, R3B8, R3C4, R3D3 and R3D5, indicate the statistical significance at the required level of significance implying that the score between the Low and the Moderate Groups is different. In contrast, the attributions R3B5, R3C6, R3C8, R3D7 and R3D8 are statistically insignificant at the required implying that they are not affected by the independent variable.

4.2.4.2 The 2nd round of MANOVA analysis for research objective 4

The second round of MANOVA aims to assess the impact of the nationality of the shipping firms on the difference of benefits generated from shipping collaborations between the shipping firms and LCP in ship-generated garbage management.

4.2.4.2.1 Assumption testing of the 2nd round MANOVA

The maximum value of Mahalanobis distance (25.190) obtained from linear regression is higher than the critical values (23.685) indicating that there is multivariate outliers and the multivariate normal distribution assumption is not

satisfied. The scatterplots between pairs of dependent variables were used to test the linearity assumption. It is found that the relationship among dependent variables is not linear implying that this assumption of MANOVA is violated. The results of Bartlett's Test of Sphericity (χ^2 =503.690, p<.000), VIF (<10) and Pearson Correlation (<.8) indicate that the moderate relationship is found among the dependent variables and multicollinearity problem does not exist. Box's Test was adopted to test Homogeneity of variance-covariance matrices of Y for group i ; i=1, 2,..,k ($\Sigma_1 = \Sigma_2 = \ldots \Sigma_k$). According to the test, the value of Box's Test (Box's M=143.384, F=1.068, p=.300) presents statistical insignificance at α=5% indicating that the observed covariance matrices of the dependent variables are equal across groups. In other words, the Homogeneity of variance-covariance matrices is not violated. Thereinafter, the error variance of an individual dependent variable was tested by using Levene's Test. In accordance with the test, the Levene's test of most attributions indicates the statistical insignificance at α=5%, except those of attributions R3B5 and R3D5, which are statistically significant at α=5 implying that the error variance of these 2 dependent variables is not equal across groups. Therefore, the level of significance for testing statistical significance of the attribution R3B5 and R3D5 was set more strictly at α=1%, while the rest of those attributions were set at α=5%.

4.2.4.2.2 Result of the 2nd round of MANOVA analysis

The next step is to select the right statistics for examining the overall effect of independent variables on the difference of dependent variables. As discussed in 4.2.4.2.1, all assumptions of MANOVA are not held except multicollinearity and Homogeneity of variance-covariance matrices assumptions which are maintained. This shows that Hotelling's Trace would outperform in this situation. The statistics of Hotelling's Trace indicates statistical insignificance at α=5% (p=.081) meaning that the independent variable has no effect on the distinction of the score. To further analyze the effect of independent variable, F-test was adopted to examine if the independent variable affects the score of each dependent variable or not. Corresponding with the outcomes, all attributions indicate statistical insignificance at α=.05, except the attributions R3A7, R3C4 and R3D3 which are statistically significant at α=5%. This means that the independent variables have an impact on the difference of score of these 3 attributions. After that, the impact of independent variables was further analyzed by using parameter estimates presented in Table 4.13.

Table 4.13 Descriptive statistics and parameter estimates (nationality of firm)

Descriptive Statistics					Parameter Estimates					
Nationality		Average	Std. Deviation	n	B	Std. Error	t	Sig.	95% Confidence Interval	
									Lower Bound	Upper Bound
R3A3	Foreign	3.733	1.0187	101	-.113	.222	-.512	.610	-.552	.326
	Thai	3.846	.9672	26	0[a]					
	Total	3.756	1.0057	127						
R3A4	Foreign	3.545	.9222	101	-.071	.204	-.348	.729	-.474	.332
	Thai	3.615	.9414	26	0[a]					
	Total	3.559	.9228	127						
R3A7	Foreign	4.208	.6053	101	-.331	.132	-2.502	.014**	-.592	-.069
	Thai	4.538	.5818	26	0[a]					
	Total	4.276	.6130	127						
R3B2	Foreign	3.307	.7449	101	-.193	.171	-1.126	.262	-.532	.146

Descriptive Statistics					Parameter Estimates					
Nationality		Average	Std. Deviation	n	B	Std. Error	t	Sig.	95% Confidence Interval	
									Lower Bound	Upper Bound
	Thai	3.500	.9055	26	0[a]					
	Total	3.346	.7805	127						
	Foreign	2.990	.8999	101	.259	.193	1.345	.181	-.122	.641
R3B3	Thai	2.731	.7776	26	0[a]					
	Total	2.937	.8796	127						
	Foreign	4.436	.6390	101	.089	.148	.604	.547	-.204	.383
R3B5	Thai	4.346	.7971	26	0[a]					
	Total	4.417	.6719	127						
	Foreign	4.337	.7386	101	.221	.168	1.315	.191	-.112	.554
R3B8	Thai	4.115	.8638	26	0[a]					
	Total	4.291	.7675	127						
	Foreign	3.208	1.0518	101	.477	.227	2.098	.038**	.027	.927
R3C4	Thai	2.731	.9616	26	0[a]					
	Total	3.110	1.0483	127						
	Foreign	3.079	.9239	101	.156	.211	.740	.461	-.262	.574
R3C6	Thai	2.923	1.0926	26	0[a]					
	Total	3.047	.9583	127						
	Foreign	3.713	.9627	101	-.018	.215	-.083	.934	-.444	.408
R3C8	Thai	3.731	1.0414	26	0[a]					
	Total	3.717	.9751	127						
	Foreign	3.347	1.1264	101	.500	.244	2.048	.043**	.017	.984
R3D3	Thai	2.846	1.0466	26	0[a]					
	Total	3.244	1.1249	127						
	Foreign	3.832	.9173	101	.486	.193	2.519	.013	.104	.867
R3D5	Thai	3.346	.6895	26	0[a]					
	Total	3.732	.8949	127						
	Foreign	3.772	1.2073	101	-.074	.266	-.278	.782	-.601	.453
R3D7	Thai	3.846	1.2229	26	0[a]					
	Total	3.787	1.2060	127						
	Foreign	4.297	.8893	101	-.165	.196	-.838	.403	-.553	.224
R3D8	Thai	4.462	.9047	26	0[a]					
	Total	4.331	.8914	127						

Remark ** Statistically significant at the .05 level.

Based on the parameter estimates in Table 4.13, the attributions R3A7, R3C4 and R3D3 indicate statistical insignificance at α=5%, whereas the rest attributions show statistical insignificance at α=5% and the attributions R3B5 and R3D5 are not significant at α=1%. This means that the independent variable has an effect on the difference of the evaluated score between the foreign and Thai shipping groups in attributions R3A7, R3C4 and R3D3.

4.2.4.3 The 3rd round of MANOVA analysis for research objective 4

The third round of MANOVA aims to assess the impact of the types of ship on the difference of benefits generated from shipping collaborations between the shipping firms and LCP in ship-generated garbage management.

4.2.4.3.1 Assumption testing of the 3rd round MANOVA

The maximum value of Mahalanobis distance (25.190) is higher than the critical values (23.685) meaning that there is multivariate outliers and the multivariate normal distribution assumption is not held. The scatterplots between pairs of dependent variables are used to test the linearity assumption. It is found that the relationship among dependent variables is not linear implying that this assumption is

violated. After that, the Bartlett's Test of Sphericity (χ^2 =503.690, p<.000), VIF (<10) and Pearson Correlation (<.8) were used to tested the multicollinearity assumption. According to the test results, the moderate relationship is found among the dependent variables and multicollinearity problem does not appear. Box's Test (Box's M=286.363, F=1.061, p=.262) is statistically insignificant at α=5% meaning that the observed covariance matrices of the dependent variables are equal across groups. The error variance of an individual dependent variable was tested by using Levene's Test. In accordance with the statistics results, the Levene's test of most attributions indicates the statistical insignificance at α=5%, except those of attributions R3D5 and R3D8, which indicate statistically insignificant at α=5% and attribution R3D7, which is significant at α=1%. This implies that the error variance of these 3 attributions is not equal across groups. Therefore, the level of significance for testing statistical significance of the above 3 attributions was set more strictly at α=1%, while those of the rest attributions were set at α=5%.

4.2.4.3.2 Result of the 3rd round of MANOVA analysis

The statistics for testing the overall effect of the independent variable on the difference of the score will be selected based on the test of hypothesis discussed in 4.2.4.3.1. All assumptions of MANOVA are not held except multicollinearity and Homogeneity of variance-covariance matrices assumptions which are maintained. This implies that Hotelling's Trace would outperform in this situation. Based on the result, Hotelling's Trace indicates statistical significance at α=5% (p=.001) meaning that the independent variable has an effect on the distinction of the score for at least one attribution. F-test indicates that the independent variable has an effect on the difference of score of 6 attributions, comprising of R3B2, R3C4, R3D3 and R3D8 which indicate statistical significance at α=1% and R3A3 and R3C8 which are statistically significant at α=5%. This implies that they are affected by the independent variable, while the rest of the attributions are not influenced by the independent variables. The effect of independent variables was further analyzed by using parameter estimates and the post hoc test. Corresponding with the results, the attribution R3B2 shows that the score evaluated by general cargo group statistically differs from that of the base group while attribution R3C4 and R3C8 indicate the difference of score between 1) bulk carrier group as well as 2) general cargo group and the base group. Likewise, the attribution R3D3 presents the difference of score between bulk carrier group and the base group. In accordance with the test, the attributions R3C8, R3B2, R3C4 and R3D3 indicate the difference of the score between the general cargo and container ship groups while the last 3 attributions demonstrate the distinction of the score between container ship and bulk carrier groups. Differently, the attribution R3C4 also shows the dissimilarity between the 1) general cargo and vehicles carrier/RoRo groups and 2) bulk carrier and vehicles carrier/RoRo groups.

4.3 Test of research hypothesis and research questions

Once the statistics results are obtained from the analysis, the research hypothesis can be tested in order to answer the research questions, as mentioned in 1.3 and 1.4 of Chapter 1.

4.3.1 Research Question 1-A: What is the current performance of the provision of garbage reception facility (GRF), under the regulations of Annex V in MARPOL 73/78, provided by Laem Chabang Port (LCP)?

This research question can be answered by using the scores evaluated by the shipping firms via the questionnaire survey. Generally, the justification of 2 experts classifies the performance, with the score higher than or equal to 3 as the acceptable performance while those with the score less than 3 are sorted as unacceptable performance. Overall, the provision of GRF by LCP is well performed in term of the physical adequacy, GRF-service price and easy procedure for the use of GRF. However, a few points that LCP should improve are the availability of the GRF service including the sorting shed, labors at the sorting shed and the collecting truck. Besides, the information regarding the GRF-related service and the location of the GRF service center etc. is insufficiently shared to the ship agents. Thus, the distribution of information through the efficient channels such as people channel and the online channel, etc., seems to be the good way to solve this challenge. The detail of performance of LCP in providing GRF is heavily explained in 4.4.1.

4.3.2 Research Question 1-B: Is the existing performance perceived differently among the groups of the shipping firms?

The answer of this research question can be found from testing Research Hypothesis 1-B which postulates that

H_0: the existing performance of GRF is perceived <u>similarly</u> among the groups of the shipping firms.
H_1: the existing performance of GRF is perceived <u>dissimilarly</u> among the groups of the shipping firms.

According to the results of MANOVA in 4.2.1, the independent variables – 1) levels of transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year), 2) nationality of shipping firms and 3) types of ships – indicate the statistical significance at α=5% implying that different groups of ship operators have distinct attitudes toward the performance in providing GRF of LCP. Based on the statistical results, there is no sufficient evidence to accept null hypothesis (H_0), in other words, the null hypothesis is rejected and the alternative hypothesis (H_1) is accepted. Therefore, it can be concluded that the existing performance of GRF is perceived dissimilarly among the groups of the shipping firms. The detail of performance of LCP in providing GRF can be found in 4.4.1.

4.3.3 Research Question 2-A: What are the factors affecting the motivation of the shipping firms to deliver their garbage at the GRF of LCP?

The answer to Research Question 2-A can be explored from the score evaluated by the shipping firms through the questionnaire survey. Based on the justification of 2 experts, the factors with the score higher than or equal to 3 is considered having the effect on the motivation of the shipping firms to deliver their ship-generated garbage at

the GRF of LCP. Generally, the delivery of ship-generated garbage of the shipping firms depends on a few factors. The first dominant factor is the international law, such as the regulations of MARPOL 73/78, etc., while the adequacy of GRF in receiving the entire amount of garbage is another factor playing on the disposal at LCP. Another vital reason is the efficiency of GRF-related operation, which should not aggravate any delay to the routine operations of ship. The ease of procedure for the use of GRF as well as the service charging fee also play the critical role on their decision to deliver ship-generated garbage at the GRF of LCP. The detail of the dominant factors can be found in 4.4.2

4.3.4 Research Question 2-B: Are motivations different among the groups of the shipping firms?

The answer of this research question can be discovered from testing Research Hypothesis 2-B which postulates that

H_0: the motivations to deliver ship-generated garbage at the GRF are <u>not different</u> among the groups of shipping firms.

H_1: the motivations to deliver ship-generated garbage at the GRF are <u>different</u> among the groups of shipping firms.

Corresponding with the results of MANOVA in 4.2.2, the independent variables – 1) levels of transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year), 2) nationality of shipping firms and 3) types of ships – indicate the statistical significance at α=5% implying that different groups of ship operators have different attitudes toward the motivation in using the GRF of LCP. Based on the statistical outcomes, there is no sufficient evidence to accept null hypothesis (H_0), in other words, the null hypothesis is rejected and the alternative hypothesis (H_1) is accepted. Therefore, it can be summarized that the motivations to deliver ship-generated garbage at the GRF of LCP are different among the groups of shipping firms.

4.3.5 Research Question 3-A: What is the relationship between levels of collaborations?

The answer of this research question can be explored from testing Research Hypothesis 3-A which postulates that

H_o: there is <u>the positive relationship</u> between paired levels of collaborations.

H_1: there is <u>the non-positive relationship</u> between paired levels of collaborations.

In accordance with the results of ordinal regression in 4.2.3, it can be seen that the positive and negative relationships between collaborations are explored depending on the paired collaborative activities. Therefore, the above postulates should be tested based on the pair of independent variables and dependent variables of each analytical

iteration. Overall, the relationship between paired variables can be summarized in Table 4.14.

Table 4.14 Positive and negative relationships between collaborations

	Positive relationship				Negative relationship			
	Cooperative collaborations (8 factors)	Coordinated collaborations (8 factors)	Synchronized collaborations (8 factors)	Total	Cooperative collaborations (8 factors)	Coordinated collaborations (8 factors)	Synchronized collaborations (8 factors)	Total
R3A1	1	4	1	6	0	0	0	0
R3A2	1	4	0	5	-1	-1	-2	-4
R3A3	2	5	5	12	-2	-2	-1	-5
R3A4	2	3	1	6	-2	0	0	-2
R3A5	2	0	1	3	-1	-2	-1	-4
R3A6	3	2	4	9	-3	-3	-2	-8
R3A7	1	5	3	9	0	0	0	0
R3B1	0	0	1	1	0	-1	0	-1
B3B2	0	1	3	4	0	-1	-2	-3
R3B3	0	0	0	0	0	-7	-6	-13
R3B4	0	0	2	2	0	-1	-2	-3
R3B5	0	1	1	2	0	0	-1	-1
R3B6	0	0	1	1	0	-2	-2	-4
R3B7	0	1	3	4	0	-1	-1	-2
R3B8	0	1	2	3	0	-3	-2	-5
R3C1	0	0	0	0	0	0	-1	-1
R3C2	0	0	1	1	0	0	-1	-1
R3C3	0	0	0	0	0	0	-1	-1
R3C4	0	0	1	1	0	0	-4	-4
R3C5	0	0	0	0	0	0	-6	-6
R3C6	0	0	1	1	0	0	-2	-2
R3C7	0	0	0	0	0	0	-4	-4
R3C8	0	0	2	2	0	0	-2	-2
Total	12	27	33	72	-9	-24	-43	-76

According to Table 4.14, the positive relationships between paired collaborations are presented in the left hand side of the table, while the negative associations are shown in the right hand side of the table. To avoid the redundancy of content, this part will demonstrate only the figures while the detail of each relationship can be explored from the discussion in 4.2.3 and 4.4.3, respectively.

4.3.6 Research Question 4-A: What are the benefits of collaborations between LCP and the shipping firms in ship-generated garbage management?

The answer to Research Question 4-A can be found from the score evaluated by the shipping firms. Based on the justification of 2 experts, the benefits with the score higher than or equal to 3 are considered having gain to shipping firms, while those with the score less than 3 are considered providing no benefits to ship operators. Based on the statistical results, the collaborations that the shipping lines think they can gain benefits from are 1) the continuous improvement of communication system which can reduce time in transferring garbage from ship to reception facility, 2) the development of advance submission of notification form for the use of GRF of LCP which can enhance ship operators' and LCP's garbage management plan and operation, 3) the projects that can increase the operational efficiency in providing GRF service and can reduce the delay to the routine operation of ship, and 4) the project that enables them to use the same database and information technology in ship-generated garbage management, which can increase their and LCP's accuracy of garbage management plan. The detail of the benefits from collaborations with LCP in managing ship-generated garbage is explained in 4.4.4.

4.3.7 Research Question 4-B: Are benefits of collaborations between LCP and the shipping firms different among the groups of the shipping firms?

The answer to Research Question 4-B can be found from testing Research Hypothesis 4-B, as follow:

H_0: the benefits of collaborations with port are not different among the groups of shipping firms.
H_1: the benefits of collaborations with port are different among the groups of shipping firms.

Corresponding with the results of MANOVA in 4.2.4, the independent variables – 1) levels of transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year), 2) nationality of shipping firms and 3) types of ships – indicate the statistical significance at α=5% implying that different groups of ship operators have different attitudes toward the benefits from collaborations with LCP in managing ship-generated garbage. Based on the statistical results, there is no sufficient evidence to accept null hypothesis (H_0), in other words, the null hypothesis is rejected and the alternative hypothesis (H_1) is accepted. Thus, it can be summarized that the benefits of collaborations with LCP in managing GRF and ship-generated garbage are different among the groups of shipping firms. The detail of the benefits from collaborations with LCP in managing ship-generated garbage can be found in 4.4.4.

4.4 Interpretation of the results

4.4.1 Research objective 1

4.4.1.1 Performance of GRF service based on 3 levels of transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year).

According to the results in 4.2.1.1, the performance score in providing GRF of LCP can be expressed in form of the scatter diagram based on the 3 levels of transactional collaborations, as shown in Figure 4.1.

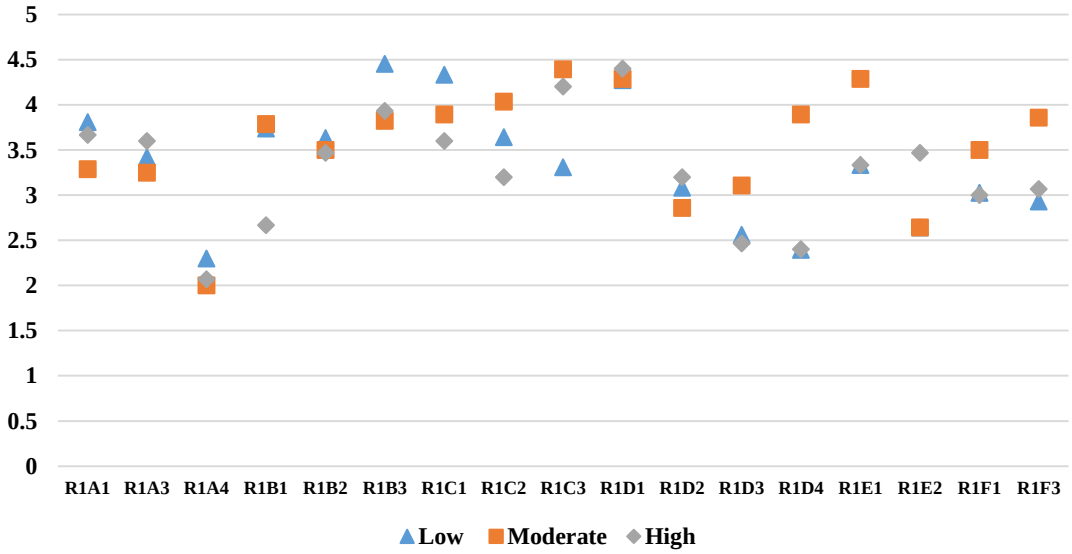

Figure 4.1 Scatter diagram of GRF performance based on 3 levels of transactional collaborations

Remark The evaluated scores which are greater than or equal to the average score of all attributions (average score=3.38) are considered acceptable while those scores which are lower the average score are considered unacceptable.

According to Figure 4.1, the scatter diagram reflects the attitudes of shipping firms toward the performance in providing GRF of LCP based on 3 levels of transactional collaborations, Low, Moderate, and High groups, which are represented by blue triangle, orange rectangle and gray diamond shapes, respectively. All in all, the performance of GRF provision is as follow:

4.4.1.1.1 The adequacy of garbage reception facility

In general, the perception of all shipping firms is not different in terms of 1) the ability to receive operational waste (R1A2), 2) the availability to provide garbage reception facility (GRF) service (R1A3) and 3) the responsibility in transferring garbage to the GRF (R1A4). All ship operators agree that Laem Chabang Port (LCP) can entirely receive ship-generated operational waste from cargo ships, while the GRF is considered relatively ready to serve. In addition, transferring process is mostly done by LCP staff indicating that LCP can handle their duty and the GRF is adequately provided by LCP. However, the operators in the Moderate group express the hesitancy that whether LCP can receive the victual and the domestic waste (R1A1). This highlights the need to further investigate and discuss about this issue.

4.4.1.1.2 The service quality

Generally, the transferring of garbage from ships to the reception facilities is completed in the agreed date and time (R1B2), despite the fact that they sometimes have to move garbage to the garbage pail terminal area because the staff, of LCP do not receive it at the agreed time (Worawut Poma, **interview**, November 4, 2016). Besides, the operational inefficiency such as waiting time before removing

garbage from ship and so on should be solved (R1B1), because it can be a major cause of delay to ships of the High group. The environmental reputation seems to be the strength of LCP because most of ship operators relatively agree that LCP can provide environmentally-friendly GRF (R1B3). This attitude indicates the success of LCP in ensuring the environmental standard.

4.4.1.1.3 The ease of the procedure

Most of ship operators, especially those in the Low group, agree that the procedure in purchasing GRF service is not complicated (R1C1) and the existing document and notification form for the use of GRF service need not to be redesigned (R1C2), because all shipping lines agree that they are easy to use. However, developing the electronic documentary system (EDS) is required by all ship operators as it can improve the transactional process between them (R1C3).

4.4.1.1.4 The cost of service

It is agreed by all ship operators that the cost of 150 Baht/vessel/day in transferring garbage from general cargo ships, container ships and coastal ships to the reception facility is reasonable (R1D1). This implies that LCP can maintain this rate. In contrast, the cost of 500 Baht/vessel/day in removing garbage by truck from bulk carriers and RO-RO vessel operators seems to be the disincentive price for ship operators in the Moderate group (R1D2). Likewise, the cost of GRF service for the mooring ships is unreasonable for the operators in the Low and High groups (R1D3). Furthermore, it seems to be unfair to ship operators in the Low and the High groups to be charged if they do not use the GRF of LCP (R1D4). Therefore, they agree that the charging policy should be laid on the GRF-use basis (R1D5).

4.4.1.1.5 The location of the reception facility

It is difficult for ship operators in the Low and the High groups to find the service center in LCP, while this is not the challenge for those in the Moderate group (R1E1). In addition, it is believed by ship operators in the low and the High groups that the delay from GRF-related activities to the regular operation of ship can be abated if the location of GRF- service center is exactly known by ship agents or representatives (R1E2). Moreover, it is agreed by all operators that the operation of GRF will be completed faster if the location of GRF service center is known (R1E3). These results highlight the importance of the location of GRF service center on the operational efficiency.

4.4.1.1.6 The accessibility of the garbage reception service information

Despite of the fact that all ship operators know where to reach the GRF-related information (R1F3), the existing sources of information are relatively inaccessible for ship operators in the Low and The High groups (R1F1). In addition, the insufficiency of information regarding GRF-related service can discourage them to

utilize the GRF of LCP, especially those in the Low and the High groups, while ship operators in the Moderate group pay less attention on the information of GRF service (R1F2).

4.4.1.2 The Performance of the GRF service based on nationality of shipping firms

According to the results in 4.2.1.2, the performance score in providing GRF of LCP can be expressed in the form of scatter diagram based on the nationality of the shipping firms, as presented in Figure 4.2.

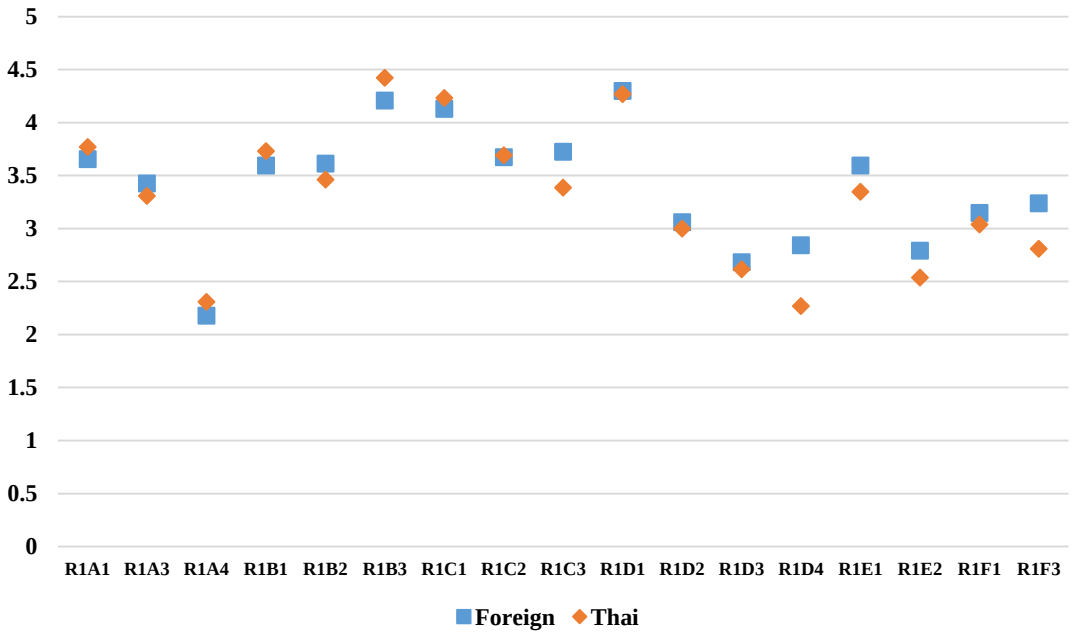

Figure 4.2 Scatter diagram of GRF performance based on nationality of shipping firms

Remark The evaluated scores which are greater than or equal to the average score of all attributions (average score=3.38) are considered acceptable while those scores which are lower the average score are considered unacceptable.

According to Figure 4.2, the scatter diagram reflects the attitudes of shipping companies toward the performance in providing GRF by LCP based on the nationality of the shipping firms – foreign and Thai groups – which are represented by blue rectangle and orange diamond shapes, respectively. In summary, the performance score in providing GRF service can be interpreted as follows.

4.4.1.2.1 The adequacy of the garbage reception facility

In general, there is no difference in the opinion of Thai and foreign shipping firms on the adequacy of GRF provided by LCP. It is agreed that LCP can receive the entire amount of victual, domestic waste (R1A1) and operational waste (R1A2). In addition, it is agreed by all operators that the GRF is available to serve at all times implying that the staff of LCP can immediately operate it without any delay

(R1A3). Moreover, the removing of all kinds of garbage is conducted by LCP staffs implying that LCP can complete their duty very well (R1A4).

4.4.1.2.2 The service quality

The transferring of garbage by the staff of LCP to the reception facility is completely done on the agreed date and at the right time (R1B2). Furthermore, it is found that the operations of GRF do not generate any delay to the routine operations of ships (R1B1) indicating that the provision of GRF is well performed by LCP. In addition, both Thai and foreign operators agree that the GRF is environmentally-friendly provided by LCP (R1B3) indicating that LCP should maintain the environmental standard at the current level.

4.4.1.2.3 The ease of procedure

It is agreed by Thai and foreign shipping companies that the procedure in purchasing GRF service of LCP is not sophisticated (R1C1). Besides, it is not worthy for LCP to redesign the notification form because all ship operators feel comfortable using it (R1C2). Besides, the introduction of electronic documentary system seems to be the worthy effort for all operators as they prefer using the paperless system to manual system (R1C3).

4.4.1.2.4 The cost of service

Both Thai and foreign shipping firms are willing to pay 150 Baht/vessel/day for transferring garbage by truck from general cargo ships, container ships and coastal ships to the reception facility (R1D1) and 500 Baht/vessel/day for transferring garbage by truck from bulk carrier to the reception facility (R1D2). However, it is unreasonable to charge ship operators with the price of 2,000 Baht/vessel/day for transferring garbage by barge from mooring ships to the reception facility (R1D3). In addition, charging all berthing ships when they do not use the GRF service is an unacceptable policy for the ship operators (R1D4). Therefore, it would be better if the payment is based on the utilization of GRF (R1D5).

4.4.1.2.5 The location of the service center

The existing location of the service center – Department of Civil Engineering of LCP – does not cause any delay to ship operations (R1E2). Furthermore, all ship operators agree that the operation of ship-generated garbage will be completed faster if the location of the service center is known in advance (R1E3). However, both Thai and foreign ship operators agree that looking for the service center sometimes is not an easy task (R1E1). Therefore, it would be reasonable for LCP to inform them with this information through the accessible channels. This topic will be discussed in the following section.

4.4.1.2.6 The accessibility of the garbage reception service information

The access to the information regarding GRF-related service is not difficult for both Thai and foreign shipping firms (R1F1). Moreover, the decision to deliver ship-generated garbage of both Thai and foreign shipping firms heavily relies on the adequacy of GRF-related information (R1F2). Therefore, it is reasonable for LCP to provide them the vital information, such as the cost of GRF service, the status of GRF availability and the estimated time in finishing GRF service, etc. However, only Thai shipping firms do not know where to reach the GRF-related information (R1F3). This highlights the additional effort for LCP to solve this challenge.

4.4.1.3 Performance of GRF service based on types of ship.

According to the results in 4.2.1.3, the performance score in providing GRF of LCP can be expressed in the form of scatter diagram based on the types of ships operated by the shipping firms, as illustrated in Figure 4.3.

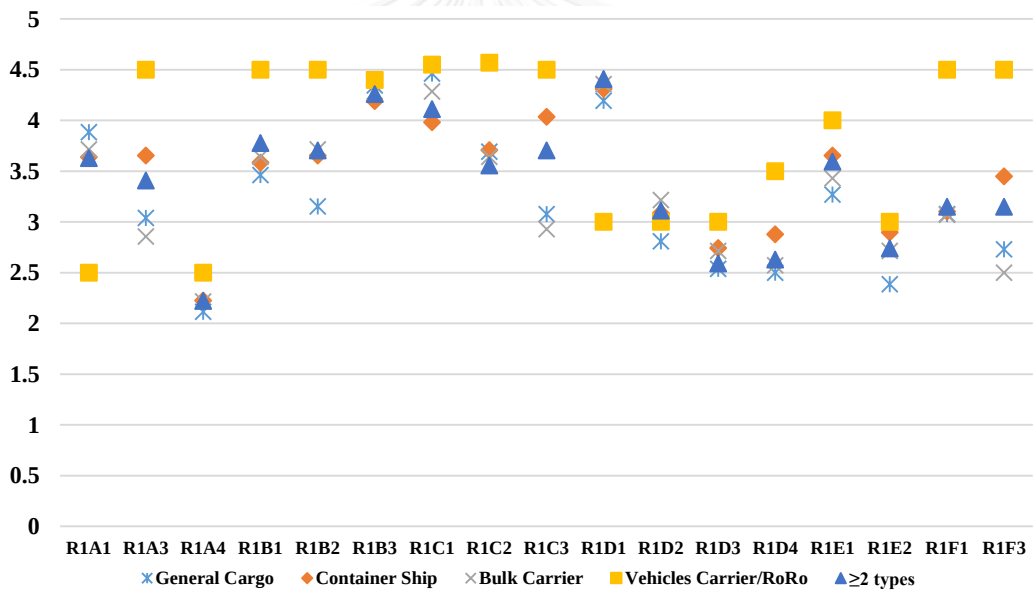

Figure 4.3 Scatter diagram of GRF performance based on types of ship operated by the shipping firms

Remark The evaluated scores which are greater than or equal to the average score of all attributions (average score=3.38) are considered acceptable while those scores which are lower the average score are considered unacceptable.

According to Figure 4.3, the scatter diagram reflects the attitudes of ship operators toward the performance in providing GRF by LCP based on types of cargo ships operated by the shipping companies. The types of ships including 1) general cargo ships, 2) container ships, 3) bulk carriers, 4) RoRo vessels and 5) more than one type of ships are represented by blue star, orange diamond, gray multiple, yellow rectangle and blue triangle shapes, respectively. In general, the performance score in providing the GRF of LCP can be interpreted as follows.

4.4.1.3.1 The adequacy of the garbage reception facility

Most of ship operators, except the RoRo and bulk carriers, agree that the GRF for receiving victual waste, domestic waste (R1A1) and operational waste (R1A2) is adequately provided. Besides, all of them disagree that they have to transfer garbage to the storage space by themselves indicating that the transferring task is completely performed by the staff of LCP (R1A3).

4.4.1.3.2 The quality of service

The GRF seems to be efficiently operated by LCP due to the fact that all ship operators, especially RoRo vessel operators, agree that there is no delay from the GRF operation (R1B1) and the transferring of ship-generated garbage to the reception facility is done on the agreed date and at the right time (R1B2). Furthermore, all of them explicitly agree that the GRF is environmentally-friendly managed by LCP indicating that the environmental standard in garbage management and operation of LCP is ensured (R1B3).

4.4.1.3.3 The ease of procedure

All ship operators indicate the optimistic attitude toward the procedure in using the GRF of LCP as they agree that the current procedure for the use of GRF of LCP is not complicated (R1C1). Moreover, the notification form for the use of GRF is agreed by all of ship operators that it can be easily understood and filled in (R1C2) implying that the existing notification form is well designed. However, it seems that all ship operators, except bulk carriers, think that the procedure for the use of GRF will be more efficient if the document is exchanged through the electronic system as all of them agree that they prefer submitting the notification form via electronic means to manual approach (R1C3). This shed light on the possibility to introduce the paperless system in the operation of GRF of LCP.

4.4.1.3.4 The cost of service

All ship operators have an optimistic expression on the price of 150 Baht/vessel/day for transferring by truck from the general cargo ships, container ships and coastal ships to the reception facility (R1D1). The similar opinion is found in the case of service charge of 500 Baht/vessel/day for transferring by truck from bulk carrier to the reception facility (R1D2). However, the charging rate of 2,000 Baht/vessel/day for the transferring by barge from mooring ship to the reception facility seems not to be reasonable for all of ship operators (R1D3). This indicates the need for LCP to reconsider the charging policy. Furthermore, all ship operators seem to be willing to pay only when they use the GRF of LCP (R1D4). They think that it is unfair to be charged for the GRF service when they do not use the GRF of LCP (R1D5).

4.4.1.3.5 The location of the service center

The location of the GRF service center seems not to be the obstruction in operating the GRF of LCP as all ship operators agree that it is comfortable for them to find this place (R1E1). In addition, they indicate that the existing location of the GRF service center does not aggravate any delay to ship operations (R1E2). Therefore, it means that there is no need for LCP to pay much attention to this topic. Nevertheless, all shipping firms agree that if the location of service center is known in advance by ship agents or representatives, the operation relating to ship-generated garbage will be completed faster (R1E3). According to this result, LCP should inform ship operators where the location of the GRF service center is in order to avoid the occurrence of delay from the GRF operation to the routine operation of ships.

4.4.1.3.6 The accessibility of the garbage reception service information

Generally, the existing source of the GRF service information is well provided by LCP because all ship operators, particularly RoRo vessel operators, agree that they can easily access to this information (R1F1). Based on this result, the improvement of information provision is not an urgent task for LCP. However, all ship operators are very sensitive to the sufficiency of information. They agree that the delivery of their ship-generated garbage at the GRF of LCP is made when they receive adequate information regarding the GRF service (R1F2). This highlights the considerable role of information distribution channel connecting with the shipping companies. LCP should ensure that the information of the GRF service is sufficiently shared to ship operators through convenient means, especially for the operators of general cargo vessels and bulk carriers, who indicate that they are unsure about where this information is provided (R1F3).

4.4.2 Research objective 2

4.4.2.1 The motivations to deliver ship-generated garbage based on 3 levels of transactional collaborations.

According to the results in 4.2.2.1, the motivations of shipping firms delivering ship-generated garbage at the GRF of LCP can be expressed in the form of scatter diagram based on 3 levels of transactional collaborations, as demonstrated in Figure 4.4.

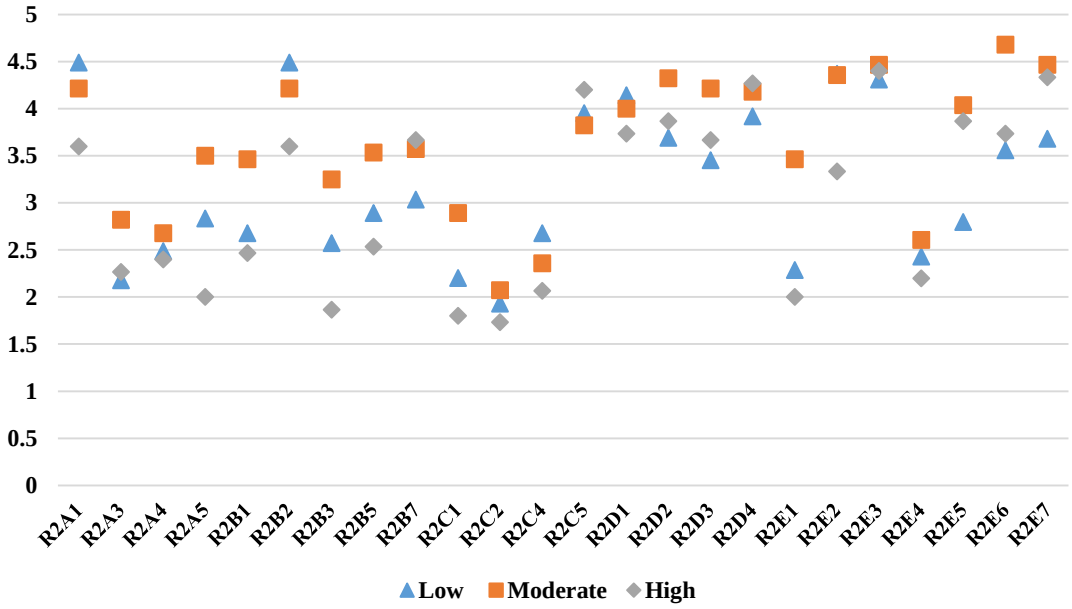

Figure 4.4 Scatter diagram of motivations based on 3 levels of transactional collaborations

Remark The evaluated scores which are greater than or equal to the average score of all attributions (average score=3.38) are considered acceptable while those scores which are lower the average score are considered unacceptable.

According to Figure 4.4, the scatter diagram reflects the attitudes of shipping firms toward the motivations in delivering ship-generated garbage at the GRF of LCP based on 3 levels of transactional collaborations - Low, Moderate, and High groups – which are represented by blue triangle, orange rectangle and gray diamond shapes, respectively. All in all, the results can be interpreted as follows.

4.4.2.1.1 Laws and regulations

In general, national laws currently provide sufficient incentive for sea carriers in the Low and the Moderate groups to discharge garbage at GRF (R2A2), while governmental agencies should increase the level of legal enforcement on shipping companies in the High group and identify the reasons why the national laws have barely any impact. At the same time, weak enforcement of the port authority's power was explored among the shipping firms (R2A4-R2A5). This highlights the need to strengthen port regulations covering ship operators' operations, especially among the Low and the High groups. Similarly, the Marine Department seems to have minimal influence on the conduct of all groups of operators (R2A3); hence, it is urged to strengthen its powers and legal enforcement of environmental management regulations. For example, enforcement through the Arrest of Ships Act (1991) on marine-environment-related faults of ships should be strengthened, while ship inspection should be enforced on any suspect vessels. Penalties should be increased and strictly enforced in order to raise awareness among shipping companies, while international conventions, such as MARPOL and SOLAS and so on (R2A1) play a critical role on the practices of ship operators.

4.4.2.1.2 Limitation of ships and ports of call

The inadequacy of reception facilities and cost of service at the previous and next ports of discharge seem to exacerbate challenges to shipping firms in the Moderate group (R2B3-R2B4). Besides, the inadequacy of onboard storage space for garbage was cited as a major problem for all operators (R2B2, R2B6). As a result, vessels remove garbage from the ships on arrival at their ports of call so as to make storage space available for the next trip.

4.4.2.1.3 Company policy

Delivery of garbage at GRF is a simple task with low investment requirement and low monetary return. Therefore, shipping company executives, especially operators in the High and Low groups, tend not to spend time or resources on the topic. All decisions regarding the delivery of garbage at port are decentralized to the firms' representatives. Discharge of ship-generated garbage depends on the day-by-day judgment of ship masters and agents at the berthing port (R2C5). No ship operators are interested in developing a long-term cooperation with LCP in terms of improving management of ship-generated garbage and provision of GRF service because this cannot greatly reduce their cost and time (R2C2-R2C4).

4.4.2.1.4 Service satisfaction

All ship operators tend to select ports that can receive the entire amount of their garbage because this alleviates the risks of marine pollution from any accidents that may cause major financial loss as a result of penalties and compensation claims. Moreover, the efficiency of the GRF service provision can generate competitive advantage in terms of speed of service to shipping firms, which can reduce waiting time at port (R2D2). Furthermore, setting reasonable port tariffs for garbage disposal will create additional competitive advantage for all container lines and incentivize shipping companies to discharge their garbage at the GRF of LCP (R2D4). In addition, shipping firms in all three groups pay close attention to the ease of procedure of using the GRF service of LCP (R2D3). The port authority; therefore, needs to streamline its operating procedures as far as possible. At the same time, adequate information regarding the GRF service should be provided via all accessible channels in order to inform decision making processes by shipping firms; establishing clear processes and expectations will lead to increased customer satisfaction (R2D1).

4.4.2.1.5 Environmental conscious

Shipping companies tend to exhibit an optimistic perception of the resilience of the marine environment. They all agree that prevention of marine pollution is a responsibility of the shipping firm (R2E3), and express full support for the requirement to bring onboard garbage back to the GRF of LCP for disposal (R2E6). Despite this favorable perspective within the maritime industry, there are numerous concerns that the Port Authority of Thailand and related agencies should take into

account. Firstly, all shipping groups except the High group, believe that marine prevention is ultimately the government's responsibility (R2E2).

4.4.2.2 Motivations to deliver ship-generated garbage based on the nationality of shipping firms

According to the results in 4.2.2.2, the motivations of shipping firms in delivering ship-generated garbage at the GRF of LCP can be expressed in the form of scatter diagram based on the nationality of shipping firms, as presented in Figure 4.5.

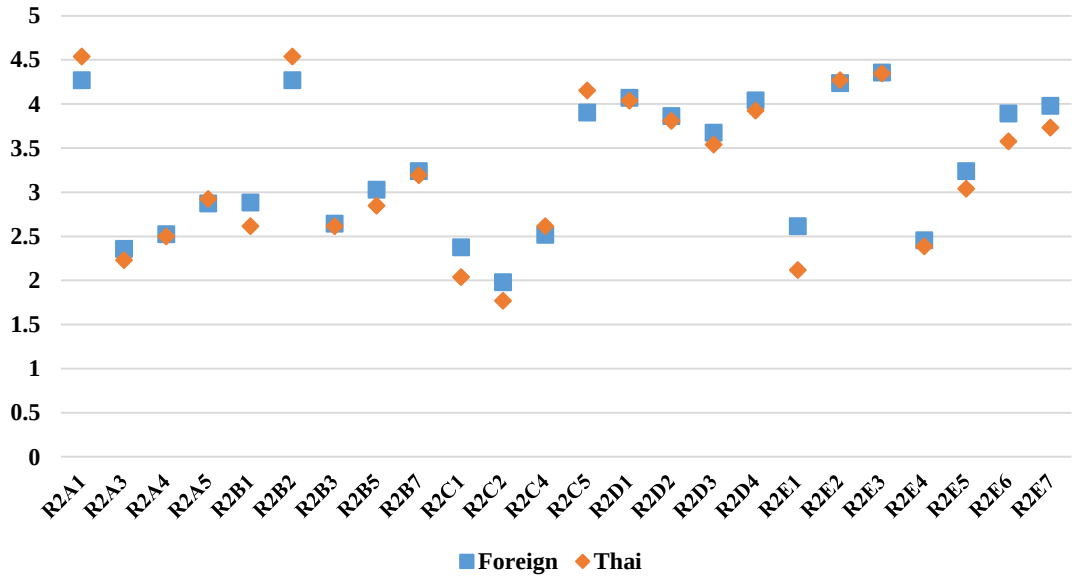

Figure 4.5 Scatter diagram of motivations based on the nationality of shipping firms

Remark The evaluated scores which are greater than or equal to the average score of all attributions (average score=3.38) are considered acceptable while those scores which are lower the average score are considered unacceptable.

According to Figure 4.5, the scatter diagram reflects the attitudes of shipping companies toward the motivations in delivering ship-generated garbage at the GRF of LCP based on the nationality of the shipping firms – foreign and Thai groups – which are represented by blue rectangle and orange diamond shapes, respectively. In summary, the finding can be interpreted as follows.

4.4.2.2.1 Laws and regulations

The international laws such as MARPOL convention, etc., as well as the national laws heavily influence the delivery of ship-generated garbage at the GRF of LCP of both Thailand foreign shipping firms (R2A1-R2A2). This shed light on the substantial role of laws on marine pollution prevention. Conversely, flag state of the foreign ships (R2A3 and R2A6), Marine Department of Thailand (R2A4) and Port Authority of Thailand (R2A5) seem to barely have an impact on the decision-making of both groups. This points out the need to further investigate the reason to explain this ineffectiveness.

4.4.2.2.2 Limitation of ships and ports of call

In addition to the lack of reception facilities at the next port of discharge (R2B3 and R2B5), being as the destination port of LCP is not the reason causing ship operators to deliver ship-generated garbage at the GRF of LCP (R2B1). Likewise, the cost for the use of the GRF at the previous and the next ports scarcely has an effect on this delivery as both ship operators agree that the overall price of GRF service of LCP is reasonable (R2B4). Nevertheless, the lack of space for storing ship-generated garbage onboard considerably dominates them. Both Thai and foreign shipping firms tend to discharge garbage when they need to make storage available for keeping garbage of the next trip (R2B2 and R2B6). The scarce choice of the GRF providers in Thailand is another vital factor forcing them to discharge their garbage at LCP (R2B7). Therefore, it is likely for both ship operators to deliver ship-generated garbage at the GRF provided by other operators if LCP is not the only choice.

4.4.2.2.3 Company policy

Both Thai and foreign shipping companies agree that they can discharge ship-generated garbage at any port of call (R2C1) depending on the decision of ship master and agent (R2C5). Furthermore, they have the similar opinion that using the GRF of LCP cannot reduce their cost and port dwell time (R2C4). This might be the reason explaining why having long term collaborations with LCP or other companies regarding GRF management has no effect on them (R2C2 and R2C3).

4.4.2.2.4 Service satisfaction

The performance in providing the GRF service of LCP has a considerable impact on the delivery of ship-generated garbage of both Thai and foreign ship operators. Initially, they indicate that the GRF is adequately provided, which enables LCP to receive the entire amount of garbage (R2D1) without any delay to the routine operation of ship (R2D2). These two factors heavily affect the delivery at the GRF of LCP. Besides, the cost of GRF service, which is reasonably set up by LCP, does not discourage them to use the GRF of LCP (R2D4). Moreover, the information of the GRF service is sufficiently supplied by LCP through convenient channels and the procedure to use the GRF of LCP is not sophisticated (R2D3) enabling them to easily manage their operation. However, they seem not to receive any incentives from LCP for the delivery of ship-generated garbage at the GRF of LCP (R2D5). The lack of incentive seems not to correspond to the recommendation of IMO that encourages all ports of call to develop ways to persuade ship operators to discharge garbage at their facilities.

4.4.2.2.5 Environmental conscious

The optimistic attitudes are explored among the shipping firms. Generally, both Thai and foreign ship operators agree that the prevention of marine pollution from ship-generated garbage is their responsibility (R2E3) together with the government agencies (R2E2). This indicates the opportunity to develop the

collaborations in managing the GRF with LCP. Besides, they agree that ship-generated garbage can harm the marine environment (R2E5) and the delivery of garbage at the GRF of LCP does not waste their time (R2E4). Thus, both of them are willing to deliver their ship-generated garbage at the reception of LCP so as to prevent marine pollution from ships. Furthermore, they agree that the GRF should be sufficiently provided as it is important for the success of this goal (R2E7). Nevertheless, the concern is found when they demonstrate that their ships, which actually are the origins of garbage, do not aggravate pollution to marine environment (R2E1). This highlights the need to clarify them how marine environment can be affected by ships.

4.4.2.3 Motivations to deliver ship-generated garbage based on types of ship

According to the results in 4.2.2.3, the motivations, based on the types of ship, of shipping firms in delivering ship-generated garbage at the GRF of LCP can be expressed in the form of scatter diagram in Figure 4.6.

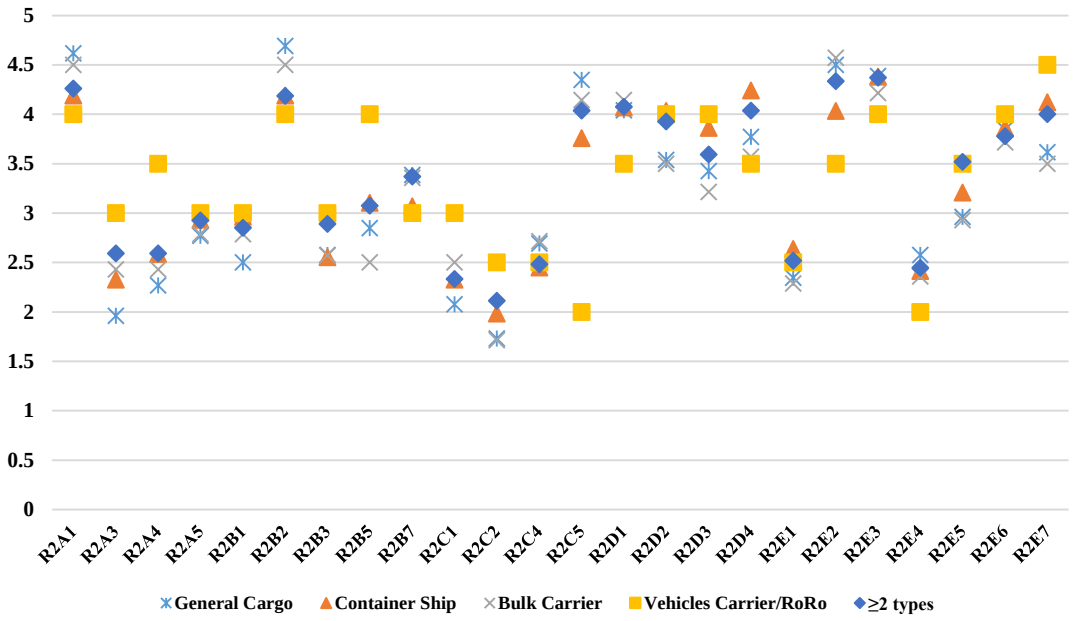

Figure 4.6 Scatter diagram of motivations based on types of ships operated by shipping firms

Remark The evaluated scores which are greater than or equal to the average score of all attributions (average score=3.38) are considered acceptable while those scores which are lower the average score are considered unacceptable.

According to Figure 4.6, the scatter diagram reflects the attitudes of shipping companies toward the motivations in delivering ship-generated garbage at the GRF of LCP based on the types of ships operated by such shipping companies. This includes 1) general cargo ships, 2) container ships, 3) bulk carriers, 4) RoRo vessels and 5) more than one type of ships, which are represented by blue star, orange triangle, gray multiple, yellow rectangle and blue diamond shapes, respectively. In general, the motivations can be interpreted as follows.

4.4.2.3.1 Laws and regulations

The international conventions have a substantial impact on the delivery of ship-generated garbage at the GRF of LCP (R2A1) while the national laws barely have an effect on the garbage delivery of all shipping lines (R2A2). Besides, the regulations of flag state do not influence the decision making of ship operators, while the Marine Department (R2A4) and the regulations of Port Authority of Thailand (R2A5) relatively dominate the delivery of garbage of the shipping firms.

4.4.2.3.2 Limitation of ships and ports of call

The decision of the all ship operators to deliver ship-generated garbage at the reception facility of LCP is not because LCP is the destination port (R2B1). Besides, the lack of the GRF of neither the previous port (R1B5) nor the next port (R2B3) is the dominant factor on their decision. In contrast, the availability of storage space onboard plays an important role on the delivery of garbage at the GRF of LCP (R2B2 and R2B6). They agree that the garbage will be removed from ships if there is no space left to keep garbage of the next trip. The cost of GRF service of the previous port and the next port is not the significant, except for the operators of RoRo vessel swho identify that the price of GRF service of the previous port is unreasonable (R2B4).

4.4.2.3.3 Company policy

The company policy of all ship operators do not force ship agents or representatives to deliver at the GRF of LCP (R2C1). In fact, the ship masters and ship agents are empowered to make a decision about this topic, except the operators of RoRo vessels (R2C5). In addition, they all agree that the long term collaborations with LCP (R2C2) as well as other private companies (R2C3) regarding GRF management have no effect on the delivery of ship-generated garbage at the GRF of LCP and the use of GRF of LCP cannot reduce their operational cost (R2C4).

4.4.2.3.4 Service satisfaction

The performance of GRF service provision considerably dominates the delivery of ship-generated garbage of all ship operators. They indicate that the GRF, which is sufficiently provided by LCP (R2D1) without causing any delay to the routine operation of ship (R2D2), influences their decision making. Generally, the cost of GRF service is also reasonable to them implying that the price of GRF service does not discourage them to use the GRF of LCP (R2D4). In addition, the procedure for the use of GRF of LCP is not complicated which facilitates the transaction of ship operators (R2D3). However, they do not receive any incentives from LCP for the delivery of ship-generated garbage at the GRF (R2D5).

4.4.2.3.5 Environmental conscious

The positive attitudes are found among ship operators. In summary, all of ship operators agree that the prevention of marine pollution from ship-

generated garbage is the duty of sea carriers (R2E3) and governmental agencies (R2E2). Besides, it is agreed by all operators that ship-generated garbage can harm marine environment (R2E5) and the delivery of garbage at the GRF of LCP does not waste their time (R2E4). Thus, they are willing to deliver their ship-generated garbage at the reception of LCP in order to prevent marine pollution. In addition, it is accepted that the GRF should be adequately provided as it is one of the critical success factors for marine pollution prevention from ship-generated garbage (R2E7). Nevertheless, they demonstrate that their ships do not cause pollution to marine environment (R2E1). This highlights the need for technical collaborations among LCP, shipping firms and educational institutions to clarify about this misconception.

4.4.3 Research objective 3

4.4.3.1 Interpretations of relationship between transactional and cooperative collaborations

The relationships between transactional and cooperative collaborations are depicted in Figure 4.7. The positive relationship is represented by the solid line while the negative relationship is represented by the dash line. The number placed beside the line is the estimated coefficient obtained from ordinal regression analysis.

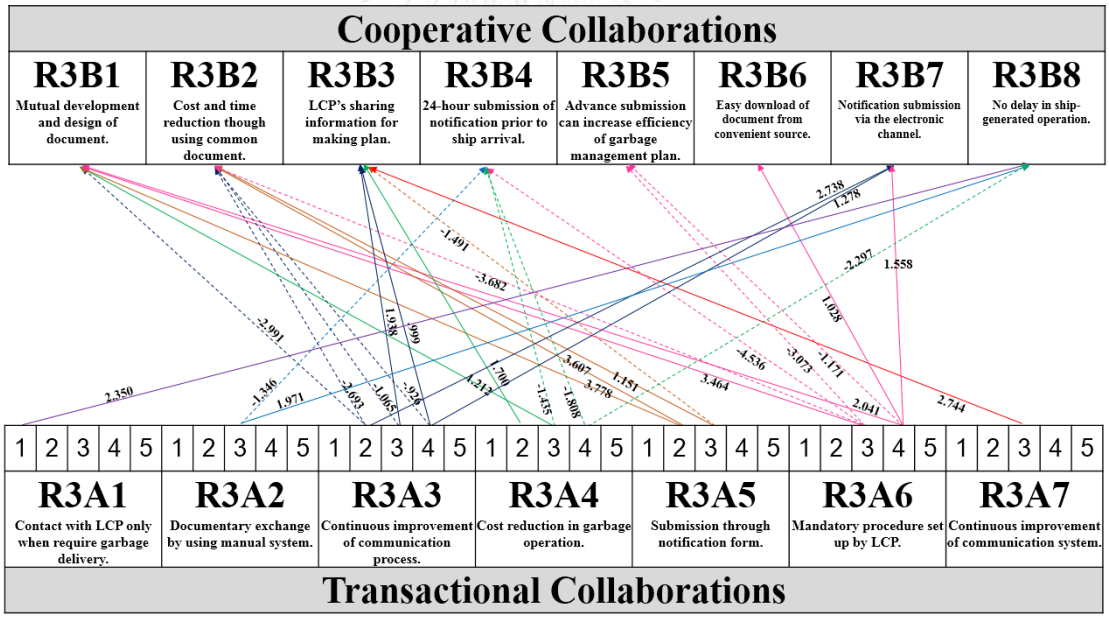

Figure 4.7 Relationship between transactional and cooperative collaborations

Remark The line (—) represents the positive relationship while (- - -) represents the negative relationship. These relationships are significant at α=5% obtained from ordinal regression analysis.

According to Figure 4.7, the mutual development and design of documents (R3B1) are the sensitive activities because they are affected by many transactional activities. LCP and shipping firms tend to develop and design the documents together when 1) they can gain benefit from operational cost reduction (R3A4), 2) the submission of notification form is required by LCP (R3A5), and 3) the procedures in using the GRF is determined by LCP (R3A6). The increase of mandatory

procedure for the use of the GRF can enhance the mutual documentary development. Conversely, the continuous improvement of communication process in using GRF (R3A3) will discourage them to mutually develop the document.

The operational cost reduction through the use of standardized documents (R3B2) can benefit LCP and the shipping firms only when the notification form is still required to submit to LCP by hand (R3A5) while the continuous improvement of communication process (R3A3), for example, ship agents send their notification form via electronic system in the standardized form instead of handwritten documents, etc., will reduce this benefit as all documents are normally in standardized form. Besides, the increasing mandatory procedure set up by LCP (R3A6) will also generate the similar effect on the above mentioned event.

Sharing of information by LCP for developing garbage management plan to ship operators (R3B3) is driven by the continuous improvement of communication process and system (R3A3). This means that the more communication process is improved by LCP, the more information will be shared between them. Furthermore, the goal of ship operators in reducing operational cost in garbage-related operations (R3A4) will encourage LCP to share more information. Thus, the shipping firms should express their demand to LCP if they desire to obtain more information. However, the sharing of information seems to be unsuccessful if the documentary exchange still depends on manual system (R3A5) because the information is shared in form of paper, which increases monetary expenses to them.

Documentary submission via manual system (R3A5) seems not to support the 24-hour advance submission of the notification form for using the GRF of LCP. If ship masters of the arriving ships need to submit the notification form by themselves, they are required to fill in the form by hand, and then send it to the staff of Department of Civil Engineering by using telex. This process can result in the transactional difficulty to ship masters. Therefore, to simplify this procedure, every arriving ship will designate the onshore ship agent to proceed this manual submission (Civil Engineering Division, 2015). Moreover, the attempt to reduce cost in garbage-related operation of the shipping firms will discourage them to perform manual submission due to high operational cost, for example, the increasing cost of paper documents. Besides, the more procedures set up by LCP, the more procedure that ship operators have to follow which results in lower possibility for ship operators to complete the 24-hour advance submission in time. This indicates that the electronic document submission should be introduced in the GRF operation if LCP desires to improve 24-hour advance submission.

The accessibility to the GRF-related documents (R3B6) depends heavily on the determination of LCP (R3A6). This implies that LCP is required to deploy the information on the accessible sources for ship operators and agents to download. Likewise, the documentary submission through the electronic system (R3A7) can be implemented only when LCP enforces to use it (R3A6). In addition, the operation of GRF can be finished in time without any delay (R3B8) when ship operators contact LCP for other port operations and the notification form is delivered to LCP 24-hour prior to the ship arrival (R3A2). The considerable emphasis on operational cost reduction of the shipping firms can aggravate a negative effect on the advance submission of notification form because they prefer saving their money to hiring the

additional representatives to deal with the documentary transaction. This will obstruct LCP staff to develop the accurate schedule for receiving garbage.

4.4.3.2 Interpretations of relationships between transactional and coordinated collaborations

The relationships between transactional and coordinated collaborations are presented in Figure 4.8.

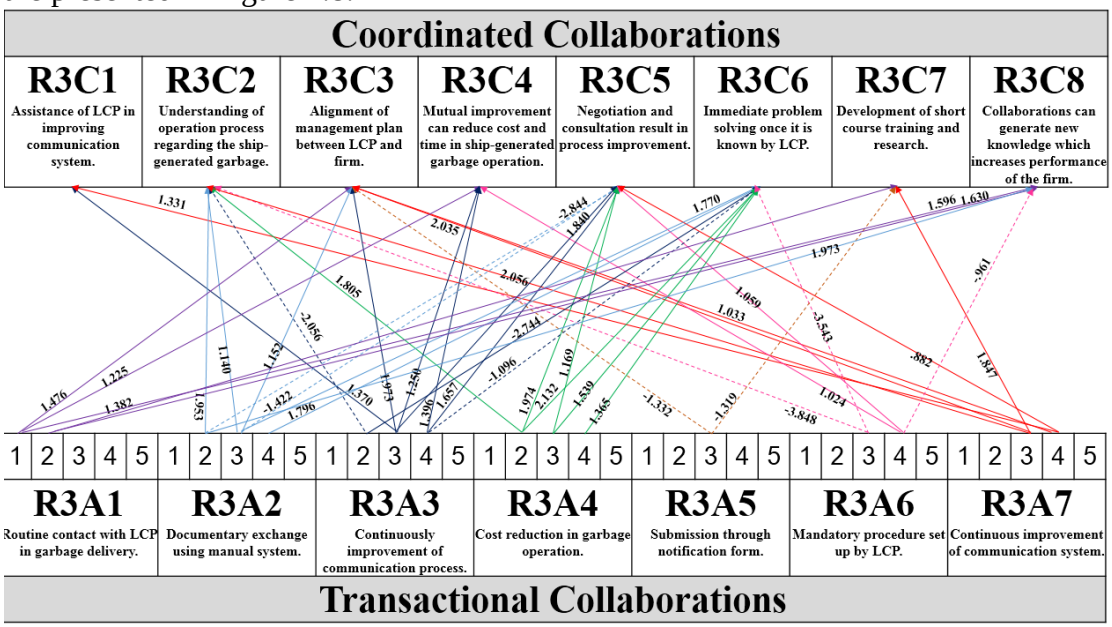

Figure 4.8 Relationship between transactional and coordinated collaborations

Remark The line (—) represents the positive relationship while (- - -) represents the negative relationship. These relationships are significant at α=5% obtained from ordinal regression analysis.

In accordance with Figure 4.8, the assistance of LCP in improving the communication system, technology and management of ship-generated garbage (R3C1) tends to increase when the communication process is improved by LCP (R3A3) as well as the entire communication systems (R3A7) are continuously improved by ship operators.

The understanding of ship operators in the operational process of ship-generated garbage of LCP (R3C2) depends on many transactional activities. Basically, the routine documentary exchange via the manual system (R3A2) is the first factor increasing the understanding of ship operators. The passion in reducing cost of operation (R3A4) is the second factor driving ship operators' attempt to understand the GRF-related process of LCP. The improvement of entire communication system by ship operators (R3A7) is the last factor enhancing the comprehension of ship operators while improving the communication process of LCP (R3A3) is not enough to enhance the understanding of ship operators. In addition, the one-sided compulsion of LCP through the procedure for the use of the GRF will obstruct the shipping firms to gain an insight about the process of garbage-related operation. Thus, the two-way communication system between LCP and ship operators seems to eliminate this challenge.

The alignment of the garbage management plan of LCP and ship operators (R3C3) depends on several transactional activities. Basically, the routine contact (R3A1) between LCP and ship operators such as ship navigation, cargo loading and discharging, cargo storage in port, and even transferring of garbage from vessels to the reception facility, etc., and the documentary exchange between them will enable ship operators to understand more about the operation of LCP (R3A2). This understanding enables shipping firms to align their garbage management plan with that of LCP. The alignment of plan can be further increased by developing either the entire communication system by ship operators or the communication process by LCP (R3A3). However, the advance submission of document through the manual system (R3A) seems to obstruct ship operators to align their plan with that of LCP.

Another coordinated activity is the mutual improvement between LCP and ship operators in reducing cost and time in the operation of the GRF and garbage-related activities (R3C4). Basically, these collaborations depend on the regular contact between them (R3A1). The more they contact during the day, the more possibility for them to mutually improve the operation of the GRF. Mutual improvement will be more conducted if either ship operators or LCP continue improving their communication process (R3A3). Finally, the higher mandatory procedures enforcing ship operators to comply, the higher possibility that they will mutually improve the operational cost and time in providing GRF service (R3A6).

The negotiation and consultation between ship operators and LCP (R3C5) heavily depend on the continuity in improving the communication system of ship operators (R3A7) and process of LCP (R3A3). The reduction of cost is another vital incentive attracting them to works more closely with LCP through the negotiation and consultation (R3A4). However, if the monetary benefits do not exist, it is unnecessary for them to coordinately work on the non-value added activities. The mandatory procedures set up by LCP also dominate these coordinated activities (R3A6). The more procedures enforced by LCP, the more likelihood for ship operators to negotiate LCP about, by what means, to improve such process so that the non-value added procedures will be eliminated. Nevertheless, the documentary exchange through manual system (R3A2) seems to impede the possibility of negotiation and consultation.

The effort of LCP in solving the problems of ship operators relies on many transactional activities. Documentary exchange is the basic function supporting the problem solving of LCP. The occurrence of difficulty will be known by LCP through the daily transaction with ship operators. The continuous improvement of the communication process of ship operators also urges LCP to assist them. However, the overemphasis on the communication improvement can decrease the intention of LCP. Thus, the optimal point should be carefully determined. In addition, the challenges will be solved faster if LCP knows that solving the problems will abate their operational cost and total cost of the shipping companies. Nevertheless, LCP tends to ignore if such problem occurs due to the mandatory procedures, which are officially set up by them.

The day-to-day contact between ship operators and LCP (R3A1) as well as the continuous improvement of communication system (R3A7) are the basic foundation of the mutual development of training courses and research. However, it would be more difficult for these coordinated collaborations to occur if the document is still submitted by hand. The over enforcement of port regulations and complicated

procedures can impair collaborations in mutually generating new bodies of knowledge between LCP and the shipping firms.

4.4.3.3 Interpretations of relationships between transactional and synchronized collaborations

The relationships between transactional and synchronized collaborations are demonstrated in Figure 4.9.

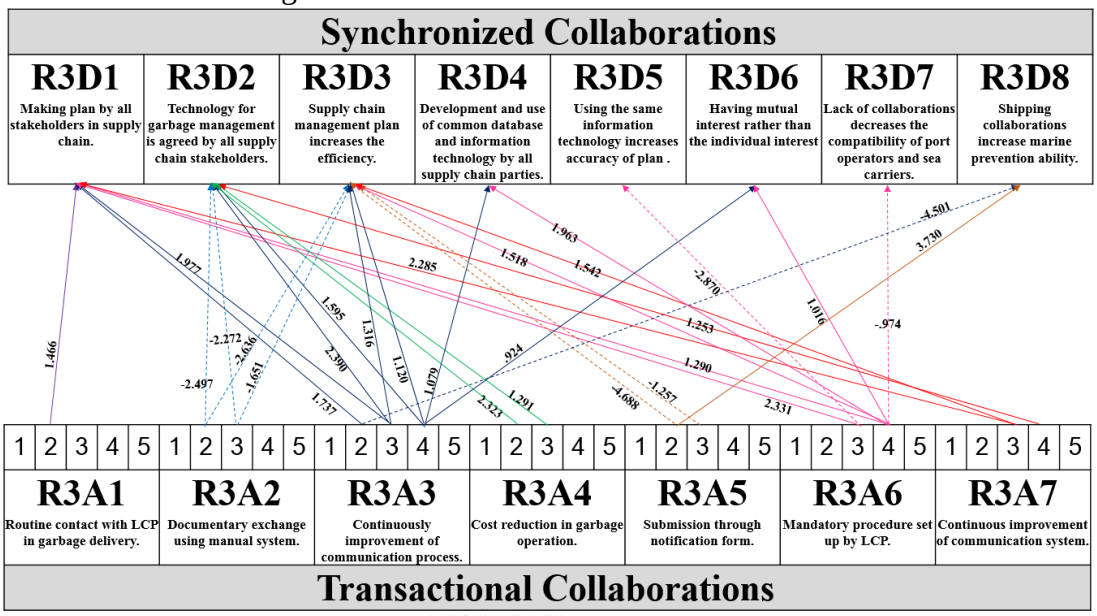

Figure 4.9 Relationship between transactional and synchronized collaborations

Remark The line (—) represents the positive relationship while (- - -) represents the negative relationship. These relationships are significant at α=5% obtained from ordinal regression analysis.

According to Figure 4.9, the finding indicates that transactional activities are the foundation of the synchronized collaborations which is the highest form of collaborations. The integrated plan (R3D1) can be generated if 1) there is the routine contact between ship operators and LCP, 2) the communication process (R3A3) and system (R3A7) are continuously improved by LCP and ship operators respectively and 3) the procedure for the use of GRF is set up by LCP (R3A6).

The use of technology, which is accepted by all supply stakeholders, in providing GRF of LCP (R3D2) is very dependent on transactional collaborations. Firstly, all of them should gain the benefits from collaborations in term of cost reduction (R3A4), or else, the collaborations will not take place. The continuous improvement of communication process (R3A3) as well as the entire systems (R3A7) are the considerable foundation supporting these synchronized collaborations. The lack of advanced communication will hamper the work of supply chain partners on the selection of technology. In addition, the documentary exchange through the manual system (R3A2) can also hinder this integrated situation. Therefore, the communication as well as documentary interchanges should be reconsidered by LCP and ship operators so as to support the synchronized collaborations.

The supply chain management plan can also increase the operational efficiency in providing the garbage reception facility (R3D3) but it substantially

depends on the increase of the advanced communication process (R3A3) and system (R3A7) and the mandatory procedure set up by LCP (R3A6). This synchronized situation will not exist if the documents (R3A2) and the notification form are still exchanged via the manual system (R3A5).

The use of common information and database by all supply chain partners (R3D4) do not much depend on transactional collaborations. Only continuous improvement of the communication process by LCP (R3A3) or; alternatively, the enforcement of ship operators to comply with the procedure (R3A6) can increase the possibility of this event to take place. The accuracy of management plan gained from using common information (R3D5) does not rely on transactional collaborations, while the increasing of mandatory procedure (R3A6) will undermine the ship operators' compatibility (R3D7). Having the common interest rather than self- interest depends on the attempt in improving communication process (R3A3) and the intensity of enforced procedures (R3D6) while the ability to prevent marine pollution partially relies on the submission of notification form by hand.

4.4.3.4 Interpretations of relationships between cooperative and coordinated collaborations

The relationships between cooperative and coordinated collaborations are illustrated in Figure 4.10.

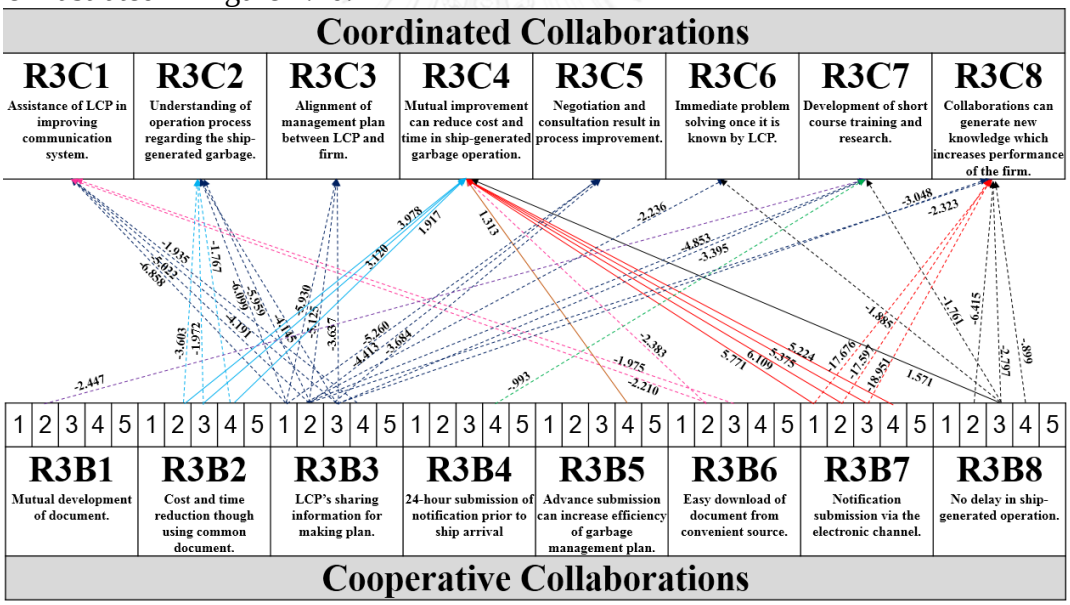

Figure 4.10 Relationship between cooperative and coordinated collaborations

Remark The line (—) represents the positive relationship while (- - -) represents the negative relationship. These relationships are significant at α=5% obtained from ordinal regression analysis.

In accordance with Figure 4.10, it is noticed that the more LCP cooperatively collaborates with ship operators, the less possibility for them to develop coordinated collaborations. This is due to the negative relationships among activities. Sharing information regarding the GRF related services of LCP (R3B3) is the most dominant factor because it hampers the possibility to occur of all coordinated activities. Based on this result, it is recommended for LCP to carefully share this information if

LCP needs to create coordinated collaborations with ship operators. The type of information should be studied prior to sharing it to ship operators. However, mutual improvement in managing GRF between them (R3C4) is still possible if the shipping companies can enjoy the monetary benefits from the use of the standardized document (R3B2) or from the reduction of delay to the operation of ship (R3B8). Furthermore, the training course will not be interested by ship operators and LCP if there is no delay in the regular operations of ships.

4.4.3.5 Interpretations of relationships between cooperative and synchronized collaborations

The relationships between cooperative and synchronized collaborations are depicted in Figure 4.11.

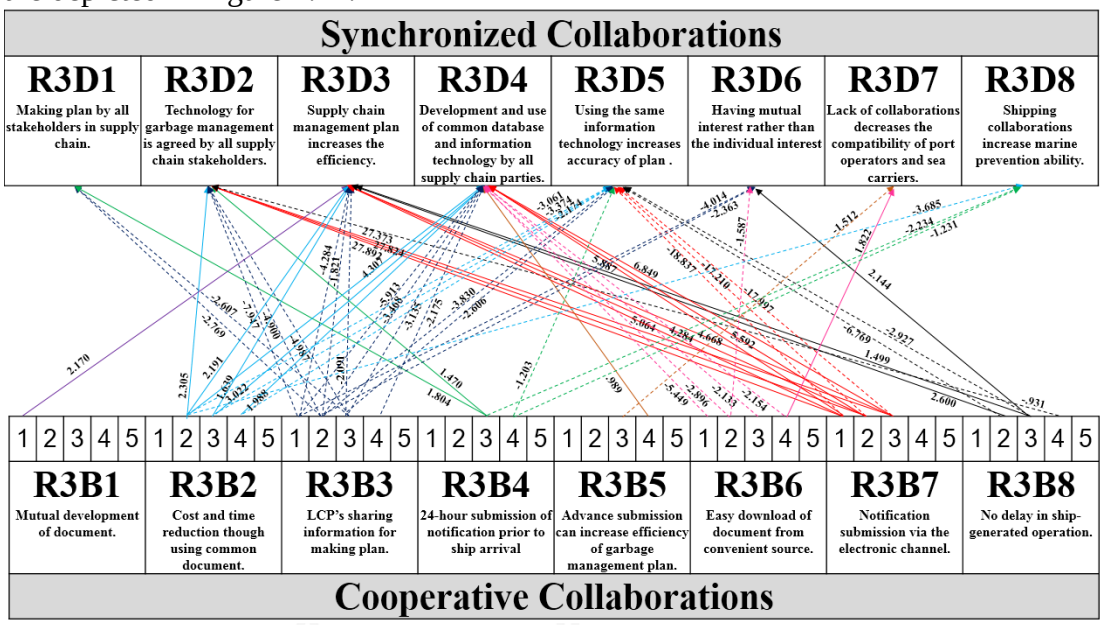

Figure 4.11 Relationship between cooperative and synchronized collaborations

Remark The line (—) represents the positive relationship while (- - -) represents the negative relationship. These relationships are significant at α=5% obtained from ordinal regression analysis.

Corresponding with Figure 4.11, it is clear that the electronic exchange of document will positively support many synchronized activities, such as the use of technology accepted by all supply chain partners (R3D2), the development of supply chain management plan (R3D3), and the use or development of common information and database (R3D4). In contrast, it is believed that the accuracy of GRF management plan (R3D5) does not depend on the use of electronic documentary system (R3B7). Another dominant cooperative factor is the incentive from the use of standardized documents (R3B2). The more cost and time can be reduced through the use of common documents, the higher possibility for supply chain partners to select the GRF technology together (R3D2), make the integrated plan together (R3D3) and develop the common information technology (R3D4). Nevertheless, the supply chain partners tend not to use the common information technology (R3D5) if they have already standardize their transactional document. Nevertheless, the possibility to take place of 6 synchronized activities (R3D1-R3D6) will be lower if LCP share more information

regarding the GRF-related services to ship operators. Hence, this shades light to the need for LCP to scrutinize the information before sharing it to the shipping firms.

Considering from the synchronized viewpoint, many synchronized activities are very sensitive to the coordinated activities. Firstly, the possibility for supply chain partners to work on the selection of the GRF-related technology (R3D2) initially depends on monetary benefits. They tend to work more closely when they can enjoy the operational cost and time reductions in collecting garbage through the use of standardized documents (R3B2). The advance submission of notification form (R3B4) through the electronic system (R3B7) is another supportive factor, while the sharing of information of LCP (R3B3) and the inexistence of delay in the regular operation of ship (R3B8) are the negative factors to the occurrence of synchronized collaborations.

Secondly, the belief that supply chain management plan can increase the operational efficiency in providing the GRF (R3D3) positively relies on the mutual development of standardized documents (R3B1), cost and time reductions from the use of standardized documents (R3B2), the documentary exchange through the electronic system (R3B7) and the inexistence of delay to the regular operation of ship (R3B8), but negatively relates to the sharing information by LCP (R3B3).

Thirdly, the development of the common information technology by all supply chain partners (R3D4) positively depends on the operational cost and time reductions in collecting garbage through the use of standardized documents (R3B2) and the submission of notification form (R3B4) through the electronic system (R3B7). This implies that if LCP standardize the document and exchange it through the electronic system can possibly increase the work among supply chain partners in developing information technology. However, the over share of information regarding the GRF-related service (R3B3) and the comfort in downloading information (R3B6) can impair the possibility of this event to occur.

4.4.3.6 Interpretations of relationships between coordinated and synchronized collaborations

The relationships between coordinated and synchronized collaborations are shown in Figure 4.12.

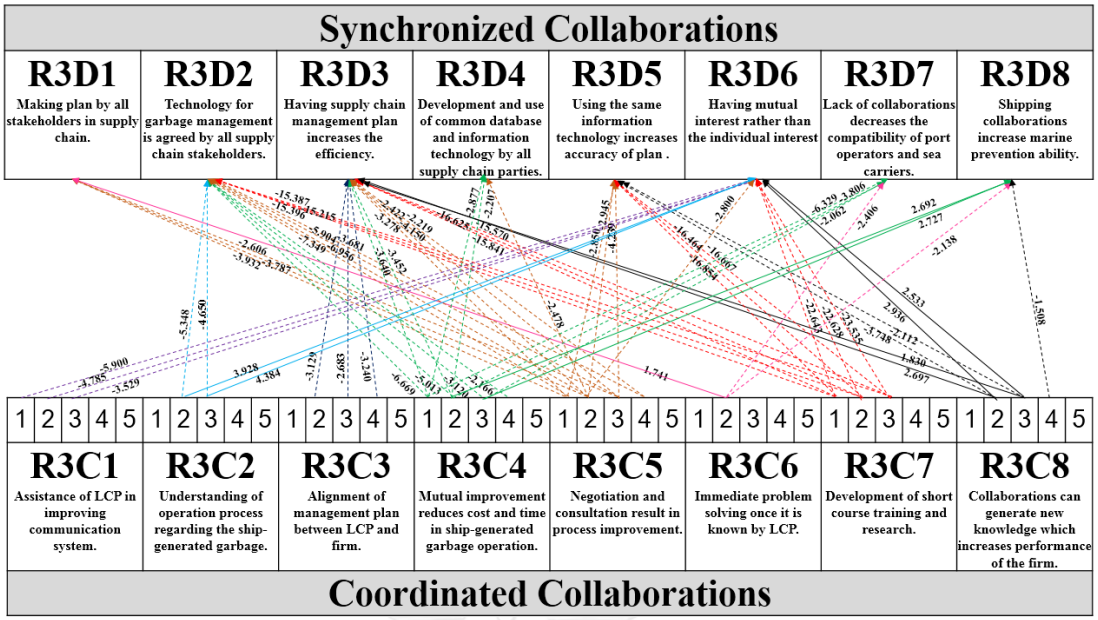

Figure 4.12 Relationships between coordinated and synchronized collaborations

Remark The line (—) represents the positive relationship while (- - -) represents the negative relationship. These relationships are significant at α=5% obtained from ordinal regression analysis.

According to Figure 4.12, it is obvious that most of synchronized and coordinated activities have a negative relationship. In other words, the more coordinated activities are oriented between LCP and ship operators in GRF operation and management, the less synchronized collaborations are formed. However, there are 3 activities that can increase the possibility in developing the synchronized collaborations. Firstly, the ship operators' understanding in the operation of ship-generated garbage of LCP (R3C2) can lead them to concentrate the overall interest of supply chain partners rather than an individual interest (R3D6). Secondly, the coordinated collaborations in reducing operational cost and time in providing garbage reception facility (R3C4) can persuade them to form green shipping collaborations, which can increase the ability of LCP to prevent marine pollution (R3D8). Ultimately, the new bodies of knowledge generated from mutual study between LCP and ship operators (R3C8) can increase the possibility of supply chain management plan to be developed by all relevant partners, which results in the increasing of operational efficiency in providing the GRF services (R3D3). Furthermore, the mutual study would be the considerable foundation of optimistic attitudes of supply chain partners (R3D6) toward the mutual interest rather than their private interest.

4.4.4 Research objective 4

4.4.4.1 Benefits of shipping collaborations based on levels of transactional collaborations

Based on 3 levels of transactional collaborations, the score of benefits from collaborations between ship operators and LCP can be expressed in the form of scatter diagram in Figure 4.13.

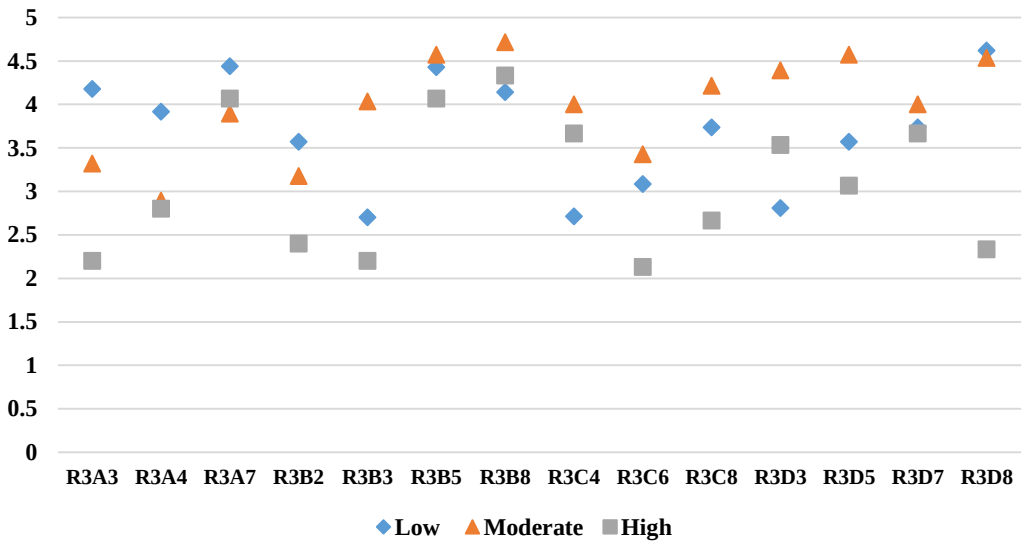

Figure 4.13 Scatter diagram of benefits from collaborations based levels of transactional collaborations

Remark The evaluated scores which are greater than or equal to the average score of all attributions (average score=3.38) are considered acceptable while those scores which are lower the average score are considered unacceptable.

According to Figure 4.13, the scatter diagram reflects attitudes of shipping firms toward the benefits received from collaborations with LCP based on 3 levels of transactional collaborations - Low, Moderate, and High groups – which are represented by blue diamond, orange triangle and gray rectangle shapes respectively. All in all, the benefits of collaborations can be interpreted as follows.

4.4.4.1.1 Benefits of transactional collaborations

All shipping firms, except those in the High group, seem to enjoy the increasing operational efficiency in providing garbage reception service through the continuous improvement of communication process, while only the operators in the Low group indicates the attempt in decreasing the total cost via the reduction of GRF-operation cost. However, all of them agree that they continue to improve the entire communication system, which can result in reduction of operational time in the provision of the GRF service.

4.4.4.1.2 Benefits of cooperative collaborations

The operators in the Low and Moderate groups tend to enjoy the reduction of operational time in using the GRF of LCP service through the documentary standardization while only the Moderate group is delighted with benefits when the information is shared by LCP. However, all groups of ship operators agree that the advance submission of notification form for the use of the GRF service of LCP can boost up the efficiency in making the garbage management plan. In addition, it is believed that the routine operation of ship will not be delayed if the transferring of garbage is completed in time.

4.4.4.1.3 Benefits of coordinated collaborations

The operators in the High and the Moderate groups agree that the mutual improvement of ship-generated garbage management with LCP can reduce time and cost of ship operation, while those in the Low group disagree with this opinion. In addition, in spite of having collaborations with LCP, the problems of the High group seem not be solved dramatically by LCP, while other operators do not encounter this disadvantage. Moreover, the operators in the High group disagree that the new bodies of knowledge can be generated through collaborations, while other operators seems to enjoy this benefit via working together with LCP.

4.4.4.1.4 Benefits of synchronized collaborations

All ship operators, except those in the Low group, agree that they can enjoy the increasing efficiency of the garbage reception service via the development of plan accepted by all stakeholders, while the accuracy of garbage management plan can be obtained when the database and information technology are commonly shared by all stakeholders. In spite of the fact that all operators believe that the lack of collaborations will decrease their compatibility, those in the High group disagree that collaborations can increase the ability of LCP to prevent marine pollution.

4.4.4.2 Benefits of shipping collaborations based on nationality of shipping firms

Based on the nationality of the shipping companies, the score of benefits gained from collaborations between ship operators and LCP can be expressed in form of scatter diagram in Figure 4.14.

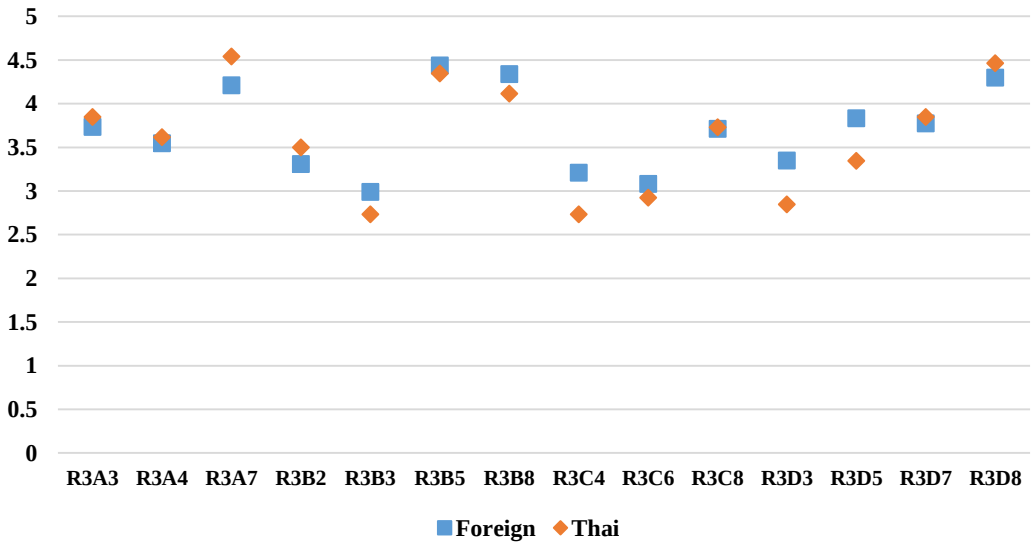

Figure 4.14 Scatter diagram of benefits from collaborations based on nationality of shipping firms

Remark The evaluated scores which are greater than or equal to the average score of all attributions (average score=3.38) are considered acceptable while those scores which are lower the average score are considered unacceptable.

According to Figure 4.14, the scatter diagram reflects attitudes of shipping companies toward the benefits of collaborations with LCP in the GRF management based on the nationality of the shipping firms – foreign and Thai groups – which are represented by blue rectangle and orange diamond shapes respectively. In summary, the benefits of collaborations can be interpreted as the following.

4.4.4.2.1 Benefits of transactional collaborations

The nationality seems not to influence the difference of the benefits of shipping firms. They agree that they can enjoy the increasing efficiency in the GRF-related operations if they continue improving communication process. Besides, the total cost of the firms can be reduced if they attempt to reduce the operational cost in using the GRF service of LCP. However, the operational time in collecting garbage from ships to the reception facility can be reduced if they keep improving the entire communication system.

4.4.4.2.2 Benefits of cooperative collaborations

Both Thai and foreign ship operators seem to gain benefits in terms of time and cost reduction through using the common documents with LCP. The advance submission of notification form can increase the efficiency of garbage management plan which results in the reduction of delay to the routine operation of ship. However, Thai shipping companies seem not to gain benefit through sharing information by LCP while the foreign firms tend to enjoy the information for making their garbage management plan.

4.4.4.2.3 Benefits of coordinated collaborations

Thai ship operators agree that they can gain the cost and time reduction from mutual improvement with LCP in ship-generated garbage management, while both groups tend to enjoy the rapid assistance of LCP in solving their problems. However, they all agree that the new bodies of knowledge can be generated when the collaborations with LCP are developed, which will result in the increasing performance of the shipping firms.

4.4.4.2.4 Benefits of synchronized collaborations

The foreign ship operators clearly believe that the increasing efficiency of the GRF service can be gained when the garbage management plan is accepted by all stakeholders, while both groups tend to enjoy the increasing accuracy of garbage management plan through using the common database and information technology. Furthermore, the collaborations with LCP not only enhance their compatibility of the firms, but also increase the ability to prevent marine pollution.

4.4.4.3 Benefits of shipping collaborations based on types of ship

Based on types of ship, the score of benefits from collaborations between ship operators and LCP can be expressed in the form of scatter diagram in Figure 4.15.

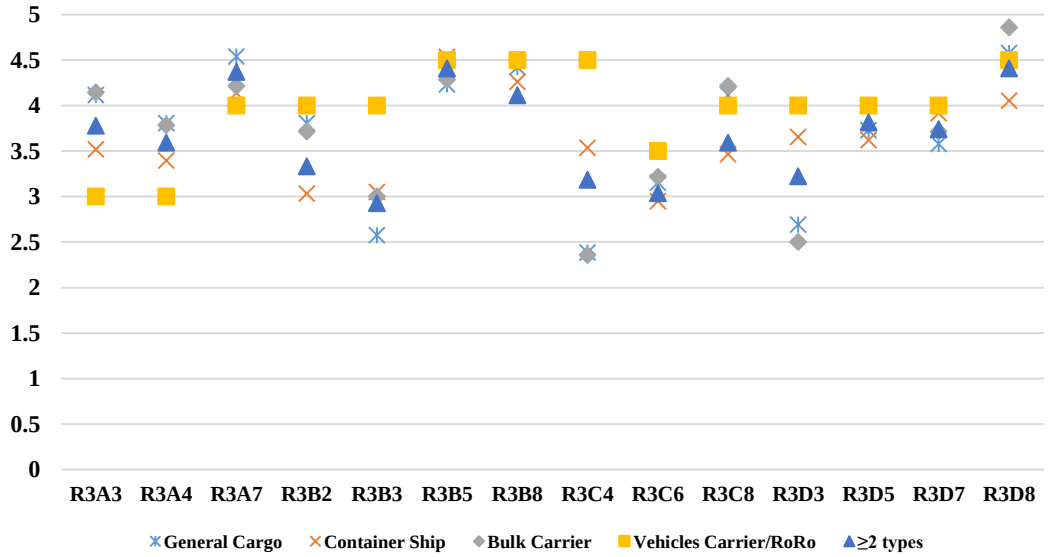

Figure 4.15 Scatter diagram of benefits from collaborations based on types of ship

Remark The evaluated scores which are greater than or equal to the average score of all attributions (average score=3.38) are considered acceptable while those scores which are lower the average score are considered unacceptable.

According to Figure 4.15, the scatter diagram reflects the attitudes of shipping companies toward the benefits obtained from collaborations with LCP based on the types of cargo ships operated by such the shipping company – 1) general cargo ships, 2) container ships, 3) bulk carriers, 4) RoRo vessels and 5) more than one type of ships – which are represented by blue star, orange multiple, gray diamond, yellow rectangle and blue triangle shapes respectively. In general the benefits of collaborations can be interpreted as follows.

4.4.4.3.1 Benefits of transactional collaborations

All of ship operators agree that they can enjoy the increasing efficiency if they continue to improve the communication process. Besides, the total cost for the shipping firms can be reduced if they attempt to reduce the operational cost by using the GRF service of LCP. However, the operational time in collecting garbage from ships to the reception facility can be reduced if they keep improving the entire communication systems.

4.4.4.3.2 Benefits of cooperative collaborations

All shipping firms seem to receive benefits in terms of time and cost reduction from using the common documents with LCP. The advance submission

of notification form can increase the efficiency of garbage management plan, which results in the reduction of delay to the routine operation of ship. However, the operators of general cargo vessel seem not to gain benefit through sharing information by LCP while the other firms tend to enjoy the information shared by LCP for making their garbage management plan.

4.4.4.3.3 Benefits of coordinated collaborations

There are only the operators of general cargo vessels and bulk carriers, who disagree that they can gain the cost and time reduction from mutual improvement with LCP in of ship-generated garbage management, while all groups tend to enjoy the rapid assistance of LCP in alleviating the problems encountered by ship operators. However, they all agree that the new bodies of knowledge can be generated when the collaborations with LCP, which result in the increasing performance of the firms.

4.4.4.3.4 Benefits of synchronized collaborations

All ship operators, except the shipping firms of general cargo vessels and bulk carriers, explicitly believe that the increasing efficiency of the GRF service can be gained when the plan is accepted by relevant stakeholders. Furthermore, they tend to enjoy the increasing accuracy of the garbage management plan through sharing the common database and information technology. Besides, the collaborations with LCP not only enhance their compatibility of the firms, but also increase the ability to prevent marine pollution.

4.5 Discussion of the results

This part aims to discuss the alignment and misalignment between the results of this study and the previous literature and research hypothesis. The results that are consistent with that in the previous studies are explained by the existing theory why those inconsistent results that cannot be explained by the current studies are further discussed by relevant theories and the interview of the shipping firms. The discussion of results is divided into 4 sections based on the research objective 1 to 4 as the following.

4.5.1 The performance in providing garbage reception facility (GRF) of LCP

The performances in providing the GRF of LCP vary depending on the groups of the shipping firms – 1) levels of transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year), 2) nationality of the firms and 3) types of ship. The levels of transactional collaborations have the highest impact on the difference of performance scores, while the nationality of the firms and the types of ships have less influence. The discussion of performances is divided into 2 cases; namely, the performances required by MARPOL 73/78 and the performances encouraged by IMO.

4.5.1.1 The performances required by MARPOL 73/78

All in all, the performances in providing the GRF required by the regulations of MARPOL 73/78 are mostly fulfilled by LCP, except one performance, which was not impressive for one group of ship operators. The results are summarized in Table 4.15.

Table 4.15 Fulfillment of LCP in ensuring the performances required by MARPOL convention

	Forced by Annex V of MARPOL 73/78	Fulfilled by LCP	Percentage of fulfillment [a]	Ship operators who are not satisfied [b]
1. The adequacy of GRF in receiving entire amount of ship-generated operational waste from different types of vessels.	✓	✓	100%	-
2. The ability to transfer ship-generated operational waste from ships to the reception facility in the agreed date, at the agreed time and the right place.	✓	✓	100%	-
3. The ability of GRF in preventing marine pollution from ship-generated garbage.	✓	✓	100%	-
4. The adequacy of GRF in receiving entire amount of the victual and domestic waste from different types of vessels.	✓	X	90%	Ro-Ro vessel

Remark [a] Percentage computed from number of ship operators that agree on the fulfillment of LCP's performance in providing GRF in comparison with the total 10 groups of ship operators included in the questionnaire survey.
[b] Groups of ship operators that are not satisfied by such the performance.

According to Table 4.15, the performances in providing the GRF required by the regulations of MARPOL 73/78 are mostly satisfied by LCP. The perfect fulfillment are found in 3 performances as follows.

1) The adequacy of GRF in receiving the entire amount of ship-generated operational waste from different types of vessels.

2) The ability to transfer ship-generated operational waste from ships to the reception facility in the agreed date, at the agreed time and the right place.

3) The ability of GRF in preventing marine pollution from ship-generated garbage.

The above results not only indicate that LCP can perform GRF well in 3 areas, but also in comply with the regulation of MARPOL 73/78 (IMO, 2002). The legal compliance of LCP points out its enthusiasm to abide by law, which corresponds to the results of Ball (1999) and Carpenter and Macgill (2005), who argued that most of seaports abide by the regulations of MARPOL convention (Ball, 1999; Carpenter and Macgill, 2005).

However, one performance that Ro-Ro vessel operators think that LCP cannot fulfil is maintaining the adequacy of GRF in receiving entire amount of the victual and domestic waste from different types of vessels, which is required by the regulation 7 of MARPOL 73/78. Therefore, it is worthy to discuss this challenge so as to explore the possible causes and by what means to alleviate this problem. Otherwise, the inadequacy of GRF of LCP will be reported to IMO, which results in the negative reputation of LCP and Marine Department, etc.

To find the possible causes of this problem, the discussion will begin with the existing operation of LCP. Generally, ship operators who desire to deliver the victual and domestic waste, which are non-hazardous garbage, are required by LCP to 1) sort it into a particular type of garbage, 2) pack it into an appropriate container and 3) place it at the garbage bins in the terminal area. The first 2 tasks are done by the onboard crew while the third task is normally responsible by the representatives of ship operators or the staff of terminal operators (Civil Engineering Division, 2015; Worawut Poma, **interview**, November 4, 2016). After that the staff of Laem Chabang Municipality (LCM) will transfer garbage from the agreed points 2 times per day – in the morning and evening of the day - to landfill for disposal (Marine Department 2008; Civil Engineering Division, 2015). The existing landfill of LCM covers 238 Rai with the capacity for garbage disposal of 400-500 tons per day (Sukunta and Wongjetjan, 2015) while the victual and domestic waste generated from LCP are generated on average 140 kilograms per day (Civil Engineering Division, 2015). The gap between the maximum capacity of landfill to dispose garbage per day and the daily amount of garbage indicates that adequacy of the GRF is not the problem like the argument of ship operators.

To further search for the real cause of the misunderstanding of ship operators, the interview of a ship agent who is working for a Ro-Ro vessel operator was conducted. He stated that there are many times that the garbage bags are not removed during the day from the terminal to the landfill making the garbage bins full. As a consequence, the pile of accumulated garbage bags impairs the operation in the terminal area causing fetid odor. Based on his argument, the insufficiency of trip in transferring garbage from LCP to the landfill of LCM seems to be the potential cause of the misunderstanding of ship operators. To solve this problem, it is recommended for LCP to urge LCM to increase the trips for transferring garbage from 2 times per day to 3 times per day or more depending on the increasing amount of ship-generated garbage during the day. This shed light on the important role of seasons during (Senarak, 2016). To do so, sharing information, such as the statistics of ships coming to berth at LCP and the amount of ship-generated garbage delivered at the GRF of LCP, etc., from Civil Engineering Division of LCP to Sanitary Landfill Center of LCM can enable them to develop the accurate garbage management plan (Lai, Wong and Lam, 2014). Another potential way adopted by leading seaports like Port of Singapore to remedy the misunderstanding of ship operators is publishing the information regarding transferring service on the official website (Maritime and Port Authority of Singapore [MPA], 2016). For example, MPA provides daily garbage collection service from ships listed in Annex A from 0730 hrs to 1730 hrs (MPA, 2016). This practice is not currently performed by LCP. Therefore, LCP is urged to follow this good practice so as to avoid the misunderstanding of ship operators.

4.5.1.2 Performances encouraged by IMO

Apart from the performances required by MARPOL 73/78, a pack of good practices in providing GRF of seaports are encouraged by IMO. All in all, 50% of the recommended practices are perfectly oriented by LCP while the rest practices are not fulfilled by LCP. The current performances of LCP are shown in Table 4.16.

Table 4.16 Fulfillment of LCP in ensuring the performances encouraged by IMO

	Encouraged by IMO	Fulfilled by LCP	Percentage of fulfillment [a]	Ship operators who are not satisfied [b]
1. The ease of communication procedures for the use of GRF service.	✓	✓	100%	-
2. The ease in filling in notification form required to submit to LCP for the use of GRF.	✓	✓	100%	-
3. The rationality of price for charging 150 Baht/vessel/day for transferring garbage by truck from general cargo ships, container ships and coastal vessels to the reception facility.	✓	✓	100%	-
4. The convenience to find the location of GRF service center in LCP.	✓	✓	100%	-
5. The ability to transfer victual and domestic waste from ships to the reception facility in the agreed date, at the agreed time and the right place.	✓	X	80%	• Bulk carrier • Ro-Ro vessel
6. The rationality of price for charging 500 Baht/vessel/day for transferring by truck from bulk carriers to the reception facility.	✓	X	80%	• Medium frequency • General cargo ship
7. The rationality of price for charging 2,000 Baht/vessel/day for transferring garbage by barge from mooring ships to the reception facility	✓	X	20%	• Low frequency • High frequency • Thai firm • Foreign firm • General cargo ship • Container ship • Bulk carrier • More than 2 types
8. The convenience to access to information of GRF-related service.	✓	X	60%	• Low frequency • Thai firm • General cargo ship • Bulk carrier

Remark [a] Percentage computed from number of ship operators that agree on the fulfillment of LCP's performance in providing GRF in comparison with the total 10 groups of ship operators included in the questionnaire survey.
[b] Groups of ship operators that are not satisfied by such the performance.

In accordance with Table 4.16, there are 4 performances that LCP can do well while the other 4 performances are not perfectly done by LCP. The perfect fulfillment of LCP in providing GRF is explored in the following performances.

1. The ease of communication procedures for the use of GRF service
2. The ease in filling in notification form required to submit to LCP for the use of GRF
3. The rationality of price for charging 150 Baht/vessel/day for transferring garbage by truck from general cargo ship, container ship and coastal vessels to the reception facility
4. The convenience to find the location of GRF service center in LCP

The above results indicate that LCP is orienting the good practices in providing the GRF, which are consistent with the recommendation of IMO (IMO, 2000, 2012, 2013). Firstly, the easy procedure for the use of GRF of LCP is the good practice aligning with the *"Guide to Good Practice for Port Reception Facility Providers and Users"* of IMO that urges seaports to simplify their communication procedures so as to not discourage ship operators to deliver ship-generated garbage at ports (IMO, 2000, 2012, 2013). Otherwise, the sophisticated procedure can discourage ship operators to bring garbage back to the port (Cho, 2009; Chen and Liu, 2013). Secondly, all groups of ship operators agree that the notification form adopted by LCP is easy to fill in. This

practice also corresponds to the recommendation of IMO that urges seaports to simplify their notification form (IMO, 2000, 2012, 2013). The complicated notification form can decrease the willingness of the shipping firms to fill in and discourage them to utilize the GRF of such ports (IMO, 2000, 2012, 2013). Thirdly, the price for charging 150 Baht/vessel/day - for transferring garbage by truck from general cargo ships, container ships and coastal vessels to the reception facility – is considered reasonable by ship operators. This indicates that LCP is adopting the competitive price affecting the overall value of port tariff which play a critical role on the choice of port selection of the shipping lines (Tongzon, Chang and Lee, 2009). The uncompetitive price of the GRF service can discourage the shipping lines to deliver ship-generated garbage (Worawut Poma, **interview**, November 4, 2016). Fourthly, the documentary system currently adopted by LCP in managing the GRF service heavily depends on manual system. Hence, recognizing the location of the GRF service center, Civil Engineering Division of LCP, is very important for ship agents and representatives. Thus, all ship operator agree that LCP can do this task well, which corresponds to the guideline of IMO (IMO, 2000, 2012, 2013).

However, the last 4 performances, as presented in Table 4.16, are not completely fulfilled by LCP. The possible causes and solutions are discussed as follows.

5. The ability to transfer victual and domestic waste from ships to the reception facility on the agreed date and time.

As previously discussed, the physical adequacy of GRF of LCP and LCM is not a problem because the existing capacity of landfill can receive and dispose the entire amount of victual and domestic waste from every ship berthing at LCP (Civil Engineering Division, 2015; Sukunta and Wongjetjan, 2015). However, the results show that the operators of bulk carriers and Ro-Ro vessels think that LCP does not transfer victual and domestic waste from ships to the reception facility on the agreed date and time. This unreliable performance can discourage ship operators to deliver their garbage at the GRF of LCP; hence, it is worthy to discuss the the possible causes and explore the suitable solutions to remedy this situation.

As previously discussed, the existing operation of LCP requires all ship operators to sort, pack and place the victual and domestic waste at the garbage bin in terminal area. The garbage bages will be transferred 2 times per day – in the morning and the evening of the day - by the staff of LCM to the landfill for disposal. Thus, the dispunctuation in transferring of garbage can take place in the morning and in the evening period of the day. The interview of a ship agent working for a Ro-Ro vessel company indicates that the garbage should be picked up at 09.30 a.m. and at 15.30 p.m. but sometimes the transferring delays for many hours resulting in the accumulation of garbage bages in the terminal area (Worawut Poma, **interview**, November 4, 2016). The possible cause of this event is discovered from the report of Pollution Control Department, which stated that transferring and disposal of garbage at the landfill of LCM sometimes cannot be proceeded due to breakdown of trucks and equipment operated by LCM (Sukunta and Wongjetjan, 2015). This argument can possibly explain

why this event takes place. Fortunately, the ship agent stated that this event does not occur often; hence, it can be concluded that this is not a severe problem.

According to the aforementioned discussion, the recommendation of this study is based on that suggested by Sukunta and Wongjetjan (2015), who urged LCM to prepare the sufficient budget to cover all machinery maintenance costs so as to avoid the machinery break down which disables them to transfer garbage from LCP to landfill at the agreed time (Sukunta and Wongjetjan, 2015). Besides, LCP should collaborate with LCM to mutually develop a consistent garbage management plan recommended by IMO (IMO, 2013). They should develop ways to ensure the sufficiency of resources used in the operations of garbage such as the collecting truck, the drivers and labors working at the landfill of LCM and the machines for handling garbage and so on. Furthermore, LCP is encouraged to share the information regarding the number of ships berthing at LCP and the number of garbage generated from the port area and delivered from ships, etc., so as to enable LCM to estimate the amount of ship-generated garbage more accurately and prepare relevant resources more precisely.

6. The rationality of the GRF-service cost of 500 Baht/vessel/day for transferring by truck from ships berthing at the bulk terminal to the reception facility and (7.) the rationality of GRF-service cost of 2,000 Baht/vessel/day for transferring garbage by barge from mooring ship to the reception facility.

Although the price of GRF service is not legally controlled by the regulations in MARPOL 73/78, all ports of call are encouraged by IMO to reasonably set up the GRF service fee in order to persuade ship operators to deliver their ship-generated garbage at GRF of such ports (IMO, 2000, 2012, 2013). The unreasonable price can discourage ship operators to use the GRF of seaports (Cho 2009; IMO, 2000; Chen and Liu, 2013). Therefore, the negative attitude of ship operators toward to GRF service fee of LCP points out the need to discuss the rational of these two prices. The discussion is based on the comparison of the GRF service fees adopted by neighboring ports including ports in Vietnam, Malaysia and Singapore, as presented in Table 4.17.

Table 4.17 Garbage collection service fees adopted by neighboring seaports

Port	Country	Size of cargo ship	Amount of garbage	At wharf (US$/time/ship)	At buoy, anchorage (US$/time/ship)	Goods and Services Tax
Saigon Port[1]	Vietnam	under 200 GT	n.a.	4	8	n.a.
		200 GT to 15,000 GT	n.a.	15	40	n.a.
		15,000 GT and above	n.a.	30	50	n.a.
Westports[2]	Malaysia	n.a.	n.a.	79.38		included
Port of Singapore[3]	Singapore	n.a.	< 1,000 k.g.	265.06		included
		n.a.	> 1,000 k.g.	636.99 / bin[a]		included
Jupong Port[4]	Singapore	n.a.	< 1,000 k.g.	227.19		included
Laem Chabang Port	Thailand	n.a.	n.a.	14.12 /vessel/day (bulk terminal)	-	n.a.
		n.a.		-	56.47 /vessel/day	n.a.

Remark [1] Saigon Port: source http://www.csg.com.vn/html/cuocngoai-e.pdf
[2] Westports: source http://www.westportsmalaysia.com/Conventional-@-Conventional_Tariff.aspx
[3, 4] Port of Singapore and Jupong Port: source http://www.mpa.gov.sg/web/wcm/connect/www/fb170ec7-8416-4bae-a33a-bf12ef8a298b/pc09-06.pdf?MOD=AJPERES
[a] Size of bin: 4.4 metres x 2.4 metres x 1.5 metres

According to Table 4.17, the charging fees for the GRF services adopted by Saigon Port in Vietnam, Westports in Malaysia, Port of Singapore and Jupong Port in Singapore are compared with those prices adopted by LCP.

In the first case, ship operators express their dissatisfaction of the GRF service cost of 500 Baht/vessel/day (14.12 US$/vessel/day) for transferring garbage from ships berthing at bulk terminal, which normally are bulk carriers with 6,855 gross tonnage (GT) on average (Civil Engineering Division, 2015). Compared with the charging rates adopted by other ASEAN ports, the price of 14.12 US$/vessel/day used by LCP seems to be cheaper than those of the others. For instance, if the charging rate of Saigon Port in Vietnam was used by LCP, the operators of bulk carriers with the size of 6,855 GT on average will be charged for at least 15 US$/time/ship. However, the total GRF service cost would be higher than 15 US$ if the transferring of garbage is more than one trip. In contrast, ship operators using GRF of LCP will be charged only 14.12 US$ per day. This indicates that the GRF-service fee adopted by LCP is lower than the rate of Saigon Port. Likewise, the fees adopted by Westports in Malaysia (79.38 US$/Time/Ship), Port of Singapore (265.06 US$/time/ship for the amount of garbage under 1,000 k.g.) and Jupong Port (227.19 US$/time/ship for the amount of garbage under 1,000 k.g.) are much higher than 14.12 US$ per day of LCP. Based on the above discussion, it can be concluded that the current price of 14.12 US$ per day adopted by LCP is the competitive price in comparison with those adopted by ASEAN ports.

In the second case, the majority of ship operators (80% of ship operators) agree that the GRF-service fee of 2,000 Baht/vessel/day (56.47 US$/vessel/day) for transferring garbage from mooring ships to the reception facility is not a competitive price. In comparison to the price adopted by Westports in Malaysia, the transferring of garbage from the anchoring ships is at least 79.38 US$/Time/Ship while the minimum rate of GRF-service fees adopted by Port of Singapore and Jupong Port for collecting garbage under 1 ton from the berthing ships are 265.06 and 227.19 US$/time/ship, respectively. It is noticed that all minimum rates charged by the neighboring seaports are higher than 56.47 US$/vessel/day, which is currently implemented by LCP. The differences between the GRF-service fees points out that the price charged by LCP is relatively competitive.

The contradiction between the negative attitude of ship operators and the rationality of the current GRF service fees adopted by LCP highlights the need to explore the possible cause of this negative attitude. To do so, a Thai ship owner of a general cargo ship, who is dissatisfied with the GRF service fees of 14.12 US$/vessel/day and 56.47 US$/vessel/day adopted by LCP was interviewed. Overall, the most considerable reason is because ship operators have no willingness to pay for this unnecessary expenditure. She argued that the attitude toward the retionaility of GRF service fee might varies depending on the profitability of the shipping firms. They are more willing to pay for the environmental expenses at any rate when the figure of the net profit is impressive. However, in the economic depression, the rates of 14.12 US$/vessel/day and 56.47 US$/vessel/day are too expensive and unreasonable for them. If they are required to choose, they will find the legal gap in Annex V of MARPOL convention in order to avoid this expense. This means that they prefer legally dumping garbage in the high sea in accordance with the disposal regulations of Annex V of MARPOL 73/78 which actually IMO does not encourage to do (IMO, 2011).

However, the dissatisfaction of ship operators towars the GRF service prices can be alleviated if they were able to gain incentives from LCP in return for their delivery of garbage at the GRF of LCP. The incentive that ship operators need the most is the discount in port tariff, which corresponds to the work of Lam and Notteboom

(2014) who argued that green port tariff (giving discounted port tariff to those who orients green pratices) can heavily draw the attraction of ship operators to conduct green pratices, such as delivery of garbage at seaports, etc. (Lam and Notteboom, 2014). Alternatively, LCP might provide the public advertisement for their merit to the society, for expample, publishing their logo or photo on the website and salute them with a short statement so that they can use it to convince the shippers, who pay attention on environmental issues, to buy their freight.

8. The convenience to access to information of GRF-related service.

The minority of shipping firms (40% of ship operators) agree that it is difficult for them to gain access to the information regarding the GRF service of LCP. The attitude of ship operators highlights the need to search for the true cause of the inconvenience to access to information, which is not encouraged to happen for IMO (IMO, 2011). In fact, ensuring the accessibility to the information regarding the GRF service is the good practice that LCP and other seaports should implement so as to facilitate ship operators in delivering their ship-generated garbage at the GRF of such ports (IMO, 2000, 2012, 2013). LCP should remember that the lack of GRF related information will reduce the utilization of GRF resulting in lower environmental performance (Ball 1999; Bateman 1996; IMO, 2000).

To explore the cause of this challenge, the staff of the shipping firm was interviewed. He stated that, in practice, most of ship agents can recognize the GRF related information only through the routine communication with the staff of LCP (Worawut Poma, **interview**, November 4, 2016). Daily, one officer of Civil Engineering Division is responsible for informing and contacting with ship agents or representatives, who contact LCP for using GRF while the other staff in the same department will be in charge of other tasks (Civil Engineering Division, 2015). According to this fact, the officer contacting with the ship agents plays the critical role on distributing GRF related information to the shipping firms. Hence, this person should aware that it is necessary to inform ship agents with the general information regarding the GRF service, such as the cost of service, the type and capacity of equipment used in operating GRF, the procedure for the use of the GRF and the responsible unit in providing GRF service and so on. Another passible way to solve this problem is providing the information of GRF service on the online source, such as website of ports, etc., which is the popular means used by many leading ports, such as port of Singapore and Rotterdam (Lam & Notteboom, 2014; MPA, 2016). Unfortunately, at the present time, the GRF service fee is the only one information supplied by LCP on the official website (http://www.laemchabangportnew.com/en/tariff.html), while the other necessary information is not provided. It is encouraged to deploy the information, such as 1) the procedure for the use of GRF of LCP, 2) the responsible unit, 3) the type and capacity of equipment for receiving garbage from ship and 4) the period in providing GRF service on the website of LCP.

4.5.1.3 Summary of performance in providing garbage reception facility (GRF) of LCP

According to the discussion in 4.5.1.1 and 4.5.1.2, the performance in providing the GRF of LCP can be summarized in Figure 4.16.

	Performances	% of fulfillment**	Priority	Causes of unfulfillment
Required by MARPOL 73/78	1. The adequacy of GRF in receiving operational waste	100%	-	-
	2. The ability to transfer ship-generated operational waste	100%	-	-
	3. The ability of GRF in preventing marine pollution	100%	-	-
	4. The adequacy of GRF in receiving the victual and domestic waste	90% / 10%	1*	The insufficiency of trip in transferring garbage from LCP to the landfill of LCM (Worawut Poma, interview, November 4, 2016).
Encouraged by IMO	1. The ease of communication procedures for the use of GRF service	100%	-	-
	2. The ease in filling in notification form to LCP for the use of GRF	100%	-	-
	3. The rationality of price for charging 150 Baht/vessel/day	100%	-	-
	4. The convenience to find the location of GRF service center in LCP	100%	-	-
	5. The ability to transfer victual and domestic waste from ships	80% / 20%	4*	Transferring and disposal of garbage at the landfill of LCM sometimes cannot be proceeded due to breaking down of truck and machines operated by LCM (Sukunta and Wongjetjan, 2015).
	6. The rationality of price for charging 500 Baht/vessel/day	80% / 20%	4*	Ship operators have no willingness to pay this unnecessary expenditure, especially in the economic depression[a].
	7. The rationality of price for charging 2,000 Baht/vessel/day	20% / 80%	2*	Ship operators have no willingness to pay this unnecessary expenditure, especially in the economic depression[a].
	8. The convenience to access to information of GRF-related service	60% / 40%	3*	No information regarding GRF service is provided on the website, only LCP's officer can inform ship operators[b].

Figure 4.16 Summary of performance in providing GRF of LCP

Remark * The priority of performances that are needed to improve is ranked basing on 1) the legal requirement of MARPOL 73/78 and 2) the encouragement of IMO respectively. After that, the priority is ranked basing on the impact scale on the number of ship operators after such the performance is improved.

** Percentage computed from number of ship operators that agree on the fulfillment of LCP's performance in providing GRF in comparison with the total 10 groups of ship operators included in the questionnaire survey.

- 1) Percentage in red color represents the number of ship operators agreeing that such the performances are not fulfilled by LCP, 2) percentage in green color represents the total number of ship operators who agree that such the performances are fulfilled by LCP and 3) percentage in orange color represents the partial number of ship operators who agree that such the performances are fulfilled by LCP.

[a] The argument from the interview of Thai ship owner but is required to conceal the name of interviewee and companies' name.

[b] The argument from the interview of ship agent but is required to conceal the name of interviewee and companies' name.

4.5.2 Factors affecting the delivery of garbage at the GRF of LCP

This part aims to discuss the factors that influence the behavior of ship operators in delivering their ship-generated garbage at the GRF of LCP. The effect of 30 factors from the literature were listed and evaluated by ship operators. At the end, 7 dominant factors remain on the list. Besides, it is found that the attitude of ship operators toward the factors varies depending on the groups of the shipping firms – 1) levels of transactional collaborations (high, moderate and low frequency of ships berthing at LCP per year), 2) nationality of the firms and 3) types of ships. Likewise, the levels of transactional collaborations play the significant role on the differences of attitude of the shipping firms while the other two groups have less influence. Thus, the points of discussion are 1) the alignment and the misalignment of factors with the previous literature, 2) the weakness in enforcing them on the practice of ship operators and 3) the possible solutions to alleviate the situation. Overall, the dominant factors are summarized in Table 4.18.

Table 4.18 Factors influencing the delivery of garbage at the GRF of LCP

Activities	Law		Limitation of ship	Environmental conscious	Percentage of affected ship operators [a]	Not affected ship operators [b]
	Forced by MARPOL 73/78	Encouraged by IMO				
1. The compliance with the regulations of MARPOL 73/78.	✓				100%	-
2. The legal enforcement of LCP as port operator and Marine Department as port state control.	✓				20%	• Low frequency • High frequency • Thai firms • Foreign firms • General cargo ships • Container ships • Bulk carriers • More than 2 types
3. The enforcement of Marine Department as the flag state control on Thai fleet.		✓			10%	• Low frequency • Medium frequency • High frequency • Thai firms • Foreign firms • General cargo ships • Container ships • Bulk carriers • More than 2 types
4. The ease of procedure for the use of GRF of LCP.		✓			100%	-
5. The incentive from LCP or Thai government agencies to ship operators regarding the delivery of ship-generated garbage at the GRF of LCP.		✓			0%	• All groups of ship operators
6. The storage space onboard for keeping ship-generated garbage is not enough for keeping the garbage that will be generated during the trip to the next port of discharge.			✓		100%	-
7. The awareness of ship operators to prevent marine pollution from ship-generated garbage.		✓		✓	100%	-

Remark [a] Percentage computed from number of ship operators that are affected by such the factor in comparison with the total 10 groups of ship operators included in the questionnaire survey.
[b] Groups of ship operators that are not affected by such the factor while the rest of ship operators that are affected by factor are not presented.

Corresponding with Table 4.18, 7 factors are classified under 3 categories – 1) law, 2) limitation of ship and 3) environmental conscious. The first category seems to

have the highest dominance on the behavior of ship operators in delivering their ship-generated garbage at the GRF of LCP as most of ship operators agree that they influence their behavior. This finding is consistent with the results found in the work of Horsman (1982), Cho (2009), Hinojosa and Thiel (2009) and Chen and Liu (2013), who argued that the regulations of the international convention, especially MARPOL 73/78, dominates the green practice of ship operators, ship master and crews (Horsman 1982; Cho 2009; Hinojosa and Thiel 2009; Chen and Liu 2013). At the same time, the available space onboard for keeping garbage and the environmental conscious of ship masters and crews also have an impact on ship operators' behavior in discharging their garbage. Similarly, this finding reconciles with the results of Cho (2009) and Chen and Liu (2013) who claimed that the two factors above play a vital role in bringing garbage to disposal at seaports of ship operators in fishery industry in Korea (Cho, 2009; Chen and Liu, 2013).

Therefore, it is worthy to discuss why these factors influence the ship operators' delivery of garbage at the GRF of LCP so as to emphasize its significance on marine pollution prevention. Conversely, the discussion of the factors that have weak influence but are encouraged by IMO will be focused on the cause of their ineffectiveness and how to improve them.

1. The compliance with the regulations of MARPOL 73/78.

All ship operators agree that the reason why they deliver their ship-generated garbage to the GRF of LCP is due to the compliance with regulations in Annex V of MARPOL 73/78 including Regulation 2 (application), Regulation 3 (disposal of garbage outside special areas) and Regulation 4 (special requirements for disposal of garbage) (IMO, 2002). This finding corresponds to that found by Horsman (1982) and Chen and Liu (2013), who argued that the regulations of MARPOL convention plays a critical role on the green pratices of ship masters and crews (Horsman 1982; Chen and Liu 2013). However, the international regulations cannot work by themselves, they must be exercised by the regulators, such as government agencies, etc., through the enforcement of national laws. This highlights the need for LCP (as port operator), Marine Department (as port state control and flag state control of Thailand) and other related governmental agencies to work closely in exploring ways to adopt the regulations of MARPOL 73/78 to the regulations in demestic laws. For example, Marine Department might adopt the Regulation 2, 3 and 4 in Annex V of MARPOL convention into the regulations under its responsibility, such as the Navigation in Thai Waters Act B.E. 2456 (1913) and the Thai Vessel Act, B.E. 2481 (1938) etc. However, Marine Department is encouraged to consider the economic impacts of the new national regulations intended to force compliance with Annex V because the unrealistic regulations may lead to higher levels of non-compliance (IMO, 2002). It is reasonable to ensure the highest possible level of flexibility in domestic regulations to permit ships the greatest range of options for complying with Annex V of MARPOL 73/78. Therefore, the collaborations with the private sector, such as ship operators, terminal operators and private contractor for garbage treatment and disposal, etc., in developing the practicable regulations are the good practice to do.

2. The legal enforcement of LCP as port operator and Marine Department as port state control.

The minority of ship operators (20% of the shipping firms) agree that the legal enforcement of LCP as port operator and Marine Department as port state control influences their delivery of garbage at the GRF of LCP while 80% of the shipping companies are not under this jurisdiction. This finding points out the weakness in exercising power of port state control of Thailand which are legally required by the Regulation 8 in Annex V of MARPOL 73/78 (IMO, 2002). Hence, Marine Department is encouraged to exercise more power by adopting and enforcing the Regulation 8 in Annex V of MARPOL convention – "*(1) a ship when in a port of another Party is subject to inspection by officers duly authorized by such Party concerning operational requirements under this Annex, where there are clear grounds for believing that the master or crew are not familiar with essential shipboard procedures relating to the prevention of pollution by garbage" and "(2) In the circumstances given in paragraph (1) of this regulation, the Party shall take such steps as will ensure that the ship shall not sail until the situation has been brought to order in accordance with the requirements of this Annex" and so on.* Based on the regulation above, Marine Department should 1) verify whether the ship, especially foreign vessels, has discharged any garbage in violation of the provisions of MARPOL regulations; 2) verify that the ship holds a valid certificate or other appropriate documentation regarding garbage operation standard; 3) investigate any operation where there are clear grounds for believing that the master or the crew of a ship are not familiar with the on-board procedures for preventing pollution by garbage; and 4) inspect the garbage record book kept aboard the ship. By doing this, Marine Department can fulfill the legal obligation under the jurisdiction of MARPOL convention.

At the same time, Marine Department is urged to work more closely with LCP in controlling the delivery of garbage at the GRF of LCP. As port operator and traffic controller, the officers of LCP can easily gain access to the delivery process of ship operators rather than the officers of Marine Department. Hence, the appropriate activities might be extended or authorized to the duty of the staffs of LCP, otherwise, the officers from Marine Department should participate in the operation of ship-generated garbage and exercise their power in the appropriate situations in order to enhance the legal enforcement. In addition, the legal and technical collaborations between Marine Department and other partners such as Pollution Control Department, Department of Industrial Works, Laem Chabang Municipality and educational institutes etc. are the good way to fulfill the regulations of MARPOL convention. They should 1) identify appropriate enforcement agencies, 2) provide legal authority and 3) develop adequate training, funding and equipment to incorporate the enforcement of Annex V of MARPOL convention into their responsibilities (IMO, 2012). Besides, all governmental agencies are encouraged to consider the economic impacts of domestic regulations intended to force compliance with Annex V because the unrealistic regulations may lead to higher levels of non-compliance. It seems appropriate to maintain the highest possible level of flexibility in domestic regulations to permit ships the greatest range of options for complying with Annex V. Furthermore, Lai et al. (2011) highlighted that the collaborations among relevant stakeholders to tackle the problem of non-compliance with the regulations is the strategy adopted by the leading

container line such as K-Line, Maersk, NYK, OOCL, etc, and giant shippers like IKEA, Mattel, Nike, Home Depot and HP, etc. (Lai et al., 2011). Therefore, working with the shipping firms, shipper and private contractor etc. seems to be the good practice for LCP and Marine Department.

3. The enforcement of Marine Department as the flag state control on Thai fleet.

The majority of ship operators (90% of the shipping firms) indicate that the enforcement of Marine Department as the flag state control has no effect on the delivery of garbage of Thai fleet. In fact, this finding is not strange because at the present time there is no national regulation for flag state control to rule the delivery of garbage at the GRF of LCP of Thai flag vessels. Furthermore, this duty is not legally forced by the regulation of MARPOL convention. It is optional for flag state to rule their flag ships. However, the flag state is encouraged by IMO to facilitate their flag vessels by informing them about the ports in foreign countries that do not have reception facilities for garbage (IMO, 2012). Thus, Marine Department should inform the aforementioned information to ship operators and encourage certain types of garbage processing equipment to be installed on ships operating under the Thai flag. In addition, the program to lessen costs to shipowners for purchasing and installing such equipment, or the requirements for installing compactors, incinerators and comminuters during construction of new ships which would be very helpful should be developed by Marine Department (IMO, 2012). To attain this goal, the technical collaborations among relevant stakeholders should be formed.

4. The ease of communication procedure for the use of GRF of LCP.

All ship operators agree that they deliver their ship-generated garbage at the GRF of LCP because of the ease of procedure in communicating with the staffs of LCP. This points out that LCP can completely fulfill this duty recommended by IMO (IMO, 2000, 2012, 2013). Besides, LCP should recognize that the complicated procedure can discourage ship operators to use the GRF resulting in lower environmental performance and illegal dump into the sea (Cho 2009; Chen and Liu 2013). The new role of modern seaports as the strategic partner in supply chain is another issue that LCP should aware because it implies the expectation of supply chain partners on the seamless operation throughout the chain (Song and Panayides 2008; Tongzon, Chang and Lee 2009). To attain this role, seaports and so do LCP need to simplify all port transactions including the communication procedure in using the GRF.

5. The incentives from LCP or Thai governmental agencies to ship operators regarding the delivery of ship-generated garbage at the GRF of LCP.

Recognizing that direct enforcement of Annex V regulations in MARPOL convention, particularly at sea, is difficult to accomplish, governments are encouraged to consider not only restrictive and punitive measures but also the removal of any disincentives, creation of positive incentives to ensure compliance with Annex V (IMO, 2012). Thus, the lack of incentives (no ship operators receive incentives) from

LCP or Thai government agencies to ship operators that deliver their ship-generated garbage at the GRF of LCP seems not to be the good practice. Theoretically, it was proved by many researchers that using the incentive scheme can draw the attention of ship operators to return their garbage to the GRF at ports (Cho, 2009). For instance, offering an incentive price to the good doers and punishing or giving a penalty to the wrong doers can encourage the shipping firms to increase their green practices (Lam and Notteboom, 2014). Besides, those who return their garbage or collect marine debris accumulated in and around port area to dispose at such ports should be compensated (Cho, 2009). The aforementioned programs are well accepted by ship operators in in Korean fishery industry (Cho, 2009). In addition, the provision of reward and buying garbage back from ship operators are another successful tools adopted in Korea (Chen and Liu, 2013).

The above examples of incentives are consistent with the recommendation of a Thai ship owner who stated that ship operators are delighted with the incentives, especially giving a discount through green port tariff, given from LCP or other Thai governmental agencies for an exchange with their delivery of garbage at the GRF of LCP. Alternatively, LCP might provide public advertisement for their merit to society, for example, publishing their logo or photo on the website and salut them with a short statement so that they can use this advertisement to convince the shippers, who pay attention on environmental issues, to purchase their spaces, etc.

6. Limitation of garbage storage space onboard

It is accepted by all groups of the shipping firms that one of the most important reason forcing them to use the GRF of LCP is due to full storage space onboard, which cannot accommodate the increasing amount of garbage generated in the next trip. Superficially, LCP, Marine Department and other governmental agencies cannot deal with this factor as it relies on ship operators' and classification societies' responsibility in controlling the design and the construction of ships. However, LCP can use the fact that all ships have limited space for keeping garbage in monitoring and controlling the delivery of ship-generated garbage basing on the characteristics of ships such as 1) types of garbage, 2) ship types and designs, 3) ship operating routes, 4) number of persons on board, 5) duration of voyage, 6) time spent in port, and 7) time spent in areas where discharge into the sea is prohibited or restricted and so on (IMO, 2012). By taking these factors into account, Marine Department (as port state control and flag state control) and LCP (as port operator) can 1) determine the adequacy of a reception facility, 2) investigate their practices and 3) calculate the quantities of garbage from ships which are not discharged to the sea in accordance with the provisions of regulations 3, 4 and 5 of Annex V of MARPOL 73/78 (IMO, 2012).

7. Environmental conscious of ship operators

All ship operators agree that they deliver their ship-generated garbage at the GRF of LCP because they are aware of preventing marine pollution from ship-generated garbage. This finding points out the optimistic attitude of ship operators toward the marine pollution prevention, which plays the critical role on the success of MARPOL 73/78 implementation (IMO, 2000, 2012, 2013). This is because the

operation of garbage onboard and the delivery of ship-generated garbage at the GRF of seaports depends largely on the opinion of ship master and crews (Jones 1995; Cho 2009; Chen and Liu 2013). Those having environmental responsiblility tend to comply with the regulations of MARPOL 73/78 and discharge their ship-generated garbage to the GRF of the destination port instead of illegally dumping into the sea (Chen and Liu 2013). Therefore, it is recommended for LCP to find the ways to maintain this positive attitude of ship operators such as continuing education through the short trainning course, which can temporarily refresh the obsolescent knowledge of ship masters and crews. A certification system should be implemented for controlling environmental standards and practices of shipping firms. In addition, this study recommends that the sustainable approach to this challenge is a complete reform of the current marine education system. Basic concepts of maritime administration should be included into tertiary education curriculum, and new programs, such as maritime transportation, logistics and supply chain management should be designed based on the international curriculum developed by IMO. Such measures will contribute to raise awareness and consciousness among students on the importance of preserving the marine environment.

According to the discussion above, the influence of factors on the motivation of ship operators in delivering their ship-generated garbage at the GRF of CLP and their cause in ineffectiveness of factors can be summarized in Figure 4.17.

	Factors	% of affected ship operators by factor	Priority	Causes of ineffectiveness
Required by MARPOL 73/78	1. The compliance with the regulations of MARPOL 73/78	100%	-	-
	2. The legal enforcement Marine Department as port state control	20% / 80%	1*	Weakness in exercising power of port state control on delivery of garbage in LCP
Encouraged by IMO	1. The managerial and technical supports from Marine Department as the flag state control on Thai fleet	10% / 90%	3*	Flag state control has no effect on the delivery of garbage of Thai fleet
	2. The ease of procedure for the use of GRF of LCP	100%	-	-
	3. The incentive from LCP or Thai governmental agencies to ship operators regarding the delivery of ship-generated garbage at the GRF of LCP	0%	2*	Lack of incentive to ship operators delivering garbage at LCP
Encouraged by IMO – Environmental conscious	1. The awareness of ship operators to prevent marine pollution from ship-generated garbage	100%	-	-
Limitation of ship	5. The storage space onboard for keeping ship-generated garbage is not enough for keeping the garbage that will be generated during the trip to the next port of discharge	100%	-	-

Figure 4.17 Summary of influences and causes of ineffectiveness of factors on the behavior of ship operators in delivering ship-generated garbage at the GRF of LCP

Remark * The priority of factors that are needed to enhance is ranked basing on 1) the legal requirement of MARPOL 73/78 and 2) the encouragement of IMO respectively. After that, the priority is ranked basing on the impact scale on the number of ship operators after such the performance is improved.

** Percentage computed from number of ship operators that are affected by such the factor in comparison with the total 10 groups of ship operators included in the questionnaire survey.

- 1) Percentage in red color represents the number of ship operators whose delivery of garbage is not affected by such the factors, 2) percentage in green color represents the total number of ship operators whose delivery of garbage is affected such the factor and 3) percentage in orange color represents the number of ship operators whose delivery of garbage is partially affected such the factor. The 80%, 90% and 0% indicate the lack of implementation of Marine Department and relevant governmental agencies.
- The cause of ineffectiveness of factors were obtained from the interview of Thai ship owner and onboard practitioners whose names were required to conceal to the public.

4.5.3 The collaborations in managing ship-generated garbage

This part aims to discuss how to adopt the collaborations 1) to improve the performances in providing GRF services that are not fulfilled by LCP, 2) to enhance the ability of Marine Department, as port state and flag state of Thailand, to prevent marine pollution from ship-generated garbage focusing on LCP's operation, and 3) to increase the possibility for LCP and ship operators to collaborate in managing ship-generated garbage. The frameworks for collaborations are developed in form of models as follows.

4.5.3.1 COSERVE Model

COSERVE Model is the model that guides LCP to adopt the collaborations with relevant partners in improving the performances in providing the GRF services that are not fulfilled by LCP. Basically, it includes the existing problems in providing the GRF of LCP, which are prioritized based on 1) the requirement of the regulations of MARPOL convention, 2) the encouragement of IMO, and 3) their impact scale on the satisfaction of ship operators after an improvement. The causes of such problems are added beside the collaboration frameworks, which guide the practitioners as well as other readers, by what means, the collaboration framework link the problems. In COSERVE Model, LCP is assigned to be the major player who initiates the collaborations with the relevant partners including 1) Laem Chabang Municipality as the provider of garbage collection service and disposal and 2) ship operators as the user of garbage reception facility. The COSERVE Model is illustrated in Figure 4.18.

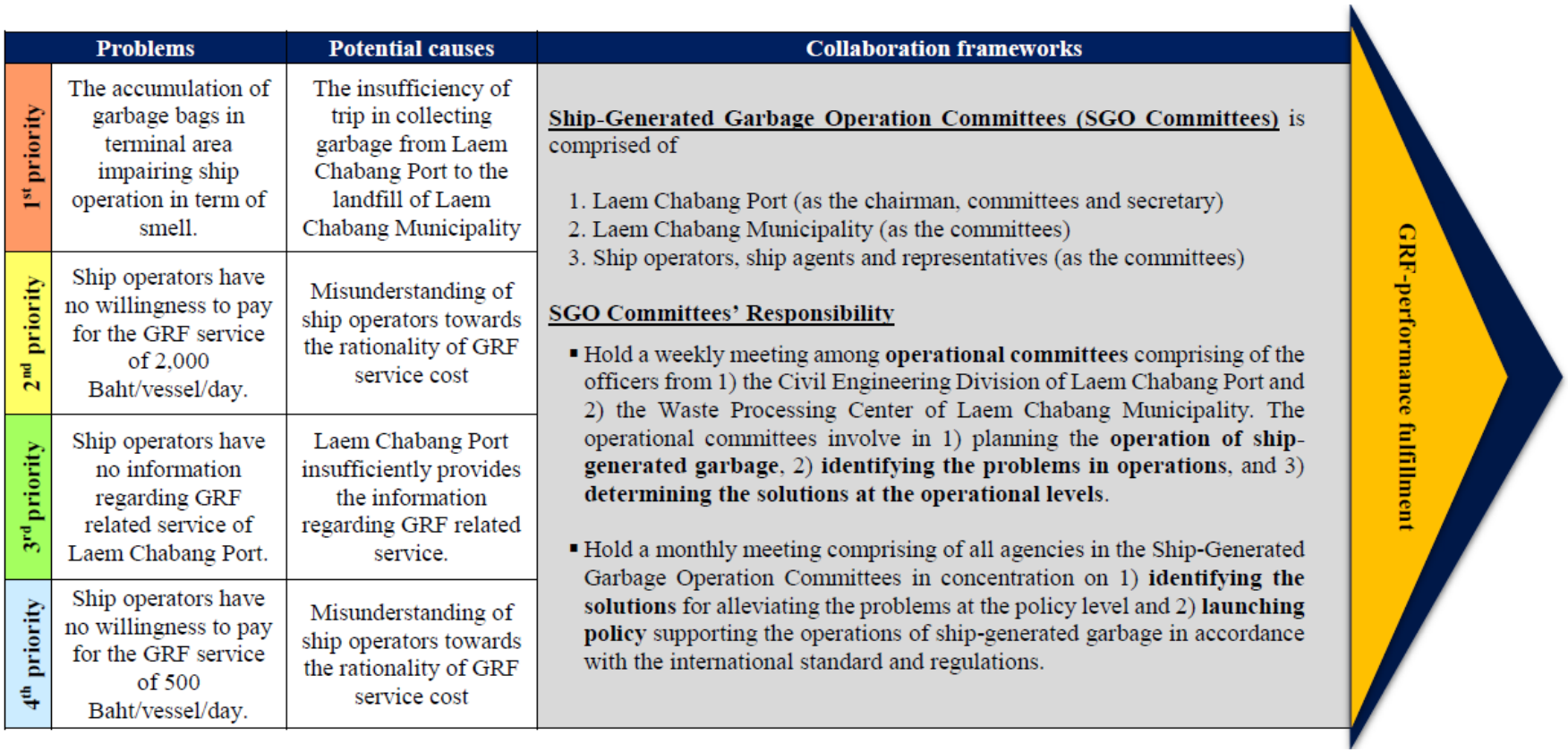

Figure 4.18 COSERVE Model for improving performances that are not fulfilled by LCP.

Remark - The collaboration frameworks are developed based on the regulations of MARPOL convention and the guidelines of IMO and were verified by Thai ship owner and onboard practitioner.
- The potential cause of problems were obtained from the interview of Thai ship owner and onboard operators.
- The collaboration frameworks were already verified by Thai ship operator and onboard operators.
- The priority is ranked based on the requirement of regulations of MARPOL convention and the impact scale on the number of ship operators after such the performance is solved.

Corresponding with Figure 4.18, the existing problems come from the questionnaire survey while the causes of problems were found from 1) document of governmental agencies and 2) the interview of ship owner and practitioners. The frameworks were developed based on 1) the theory explored in the previous study, 2) the regulations and guidelines of IMO and 3) the recommendations from expert in maritime transportation. COSERVE Model was already verified by one Thai ship owner, one former ship master and one ship agent through the face-to-face interview. They point out the possibility of this model to be implemented in practice.

Conceptually, the priority of tasks, as shown on the right hand side of the model, implies that each task should be achieved in order from 1 to 4. For collaborations, LCP is the main player who initiates the collaborations with the 1) Laem Chabang Municipality and 2) ship operators working as the committees in **Ship-Generated Garbage Operation Committees (SGO Committees)**. The operational officers, as one group of SGO committees, are required to hold the weekly meeting for 1) planning garbage management and operation, 2) following up their performances as well as 3) identifying the problems in providing the GRF service. The solutions for uncomplicated operational problems should be identified in this weekly meeting. In contrast, the solutions for the large problems should be discussed in the monthly meeting which comprises of all agencies in SGO committees. They are required to work on alleviating the complicated problems or developing incentive for persuading ship operators to deliver their ship-generated garbage at the GRF of LCP, which is one of the most popular means that the leading port such as ports of Antwerp, Rotterdam and Singapore and Shanghai. For instance, ports of Rotterdam and Antwerp were among the pioneers participating in the Environmental Ship Index (ESI). Shipping companies can register their ships for this index on a website superintended by IAPH and designed by the World Ports Climate Initiative (WPCI). The ESI is a clear example of incentive pricing at the level of port dues because seagoing ships with a score ESI score will be granted a discount on tonnage dues in Antwerp (Lam and Notteboom, 2014).

4.5.3.2 COMARPOL Model

COMARPOL Model is the model guiding, by what means, to use the collaborations between Marine Department and relevant partners in enhancing marine pollution prevention from ship-generated garbage under the regulations of MARPOL convention. It is primarily created for increasing the ability of Marine Department of Thailand, as port state and flag state, to 1) fulfill their legal obligations in accordance with the regulations of MARPOL 73/78, 2) exercise their power through the national laws in the way that is consistent with international regulations, and 3) work with relevant partners in exploring in what way to increase the environmental standard in Thai seaports' operation through the legal collaborations. The COMARPOL Model is depicted in Figure 4.19.

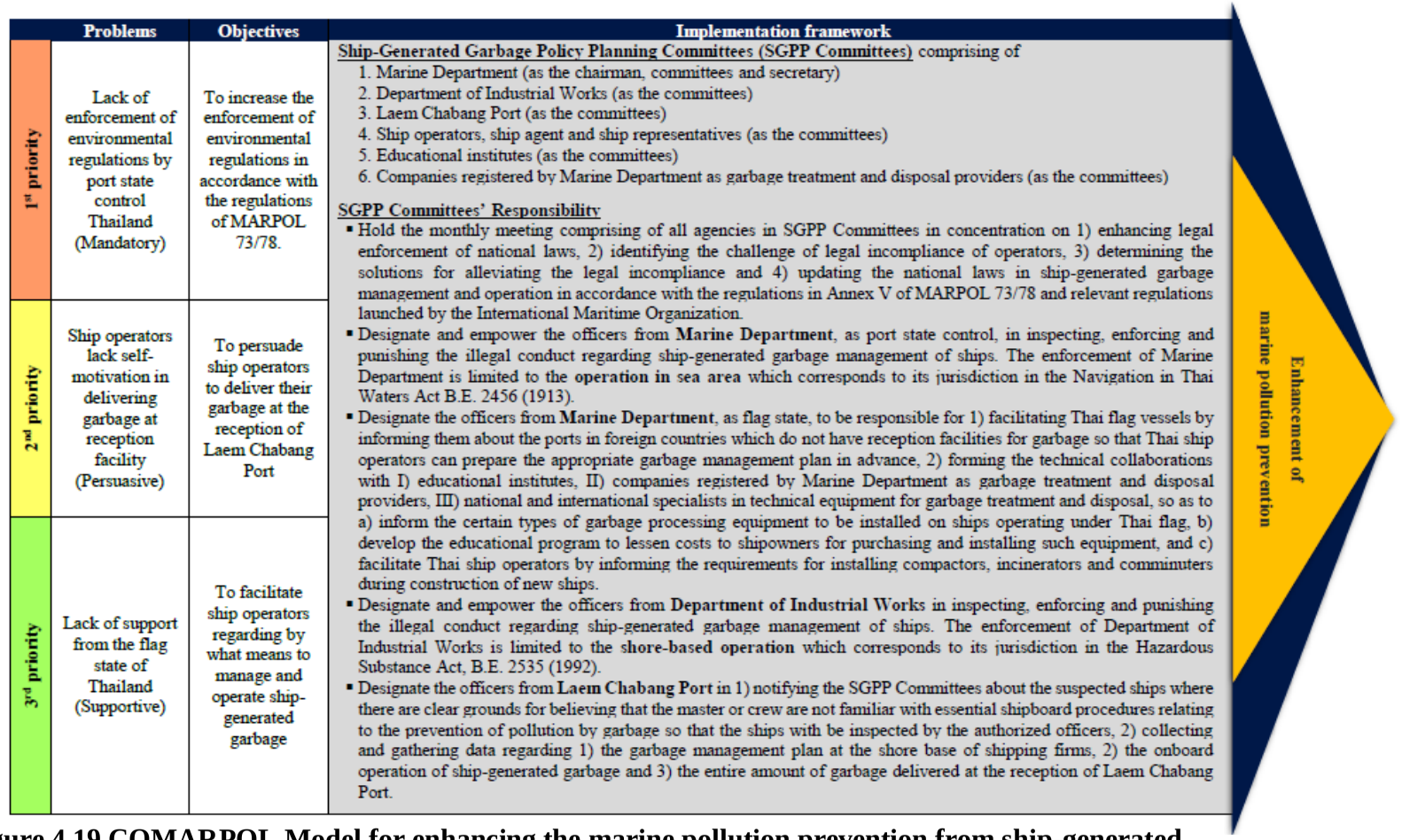

Figure 4.19 COMARPOL Model for enhancing the marine pollution prevention from ship-generated

Remark -The collaboration frameworks are developed based on the regulations of MARPOL convention and the guidelines of IMO. They were already verified by Thai ship owner and onboard practitioner.
- The potential cause of problems were obtained from the interview of Thai ship owner and onboard operators and the collaboration frameworks were already verified by Thai ship operator and onboard operators.
- The priority is ranked based on the requirement of regulations of MARPOL convention and the impact scale on the number of ship operators after such the performance is solved.

In accordance with Figure 4.19, the existing problems in COMARPOL Model come from the questionnaire survey, while the causes of problems were found from 1) document of governmental agencies and 2) the interview of ship owner and practitioners. The frameworks were developed based on 1) the theory explored in the previous study, 2) the regulations and guidelines of IMO and 3) the recommendations of ship owner and practitioners. Similarly to COSERVE Model, COMARPOL Model was already verified by one Thai ship owner, one former ship master with 10-year experience and one ship agent through the face-to-face interview. They agree on the possibility of this model to be implemented in practice.

Generally, the elements of COMARPOL Model are similar to those in COSERVE Model. It begins with the problems in exercising legal power of Marine Department and other governmental agencies of Thailand for managing ship-generated garbage at LCP. Each problem is already prioritized based on the requirement of the regulations of MARPOL convention and the encouragement of IMO. The causes of the problems are presented next to the collaboration frameworks, which guide Marine Department and relevant agencies how to adopt the collaborations in solving the problems. Likewise, Marine Department and relevant parties are required to work as the committees called "**Ship-Generated Garbage Policy Planning Committees (SGPP Committees)**" which comprise of 1) Marine Department (as the chairman, committees and secretary), 2) Department of Industrial Works (as the committees), 3) Laem Chabang Port (as the committees), 4) Ship operators, ship agent and ship representatives (as the committees), 5) Educational institutes (as the committees), and 6) Companies registered by Marine Department as garbage treatment and disposal providers (as the committees). The major responsibilities of SGPP Committees are to hold the monthly meeting comprising of all agencies so as to 1) explore the ways to enhance the legal enforcement of national laws, 2) identify the challenge of legal incompliance of relevant operators, 3) determine the solutions for alleviating the legal incompliance and 4) update the regulations of national laws regarding ship-generated garbage management and operation in accordance with the regulations in Annex V of MARPOL 73/78 and relevant regulations adopted by the International Maritime Organization.

4.5.3.3 COOP Model

This part aims to guide LCP how to collaborate with ship operators in managing ship-generated garbage by using COOP Model developed in order to increase the possibility in initiating collaborations between LCP and the shipping firms. In the first part of this section, process in developing COOP Model is explained, while the final part includes the explanation of how to adopt COOP Model.

4.5.3.3.1 Basic concepts in COOP Model

COOP Model is comprised of 7 activities, which can be classified into 2 groups - 1) activities that ship operators must comply with the procedure of LCP and 2) activities that ship operators are not required to implement by the procedure of LCP, that increase the possibility to occur of the collaborations

between LCP and ship operators in managing ship-generated garbage. All in all, the 7 activities are presented in Table 4.19.

Table 4.19 The overall results of activities on collaborations

Activities	Required by procedure of LCP	Not required by procedure of LCP	Overall effect on collaborations*
1. Routine communication between ship operators and LCP when they need to deliver their ship-generated garbage to the GRF (R3A1).	✓		+6
2. Setting up the procedures for the use of GRF by LCP (R3A6).	✓		+1
3. Using the manual system for submitting the notification form from ship operators to LCP (R3A5).	✓		(-1)
4. Advance submission (24 hours prior to the arrival of ship) of notification form for the use of garbage reception facility to LCP (R3B4).	✓		(-1)
5. Continuous improvement of the communication system of LCP (R3A3).		✓	+9
6. The continuous improvement of the communication system of the shipping firms (R3A7).		✓	+8
7. The attempt of the shipping firms in reducing cost regarding the operation of ship-generated garbage (R3A4).		✓	+4

Remark * The overall effect each factor on collaborations is calculated from subtraction between total positive effects and total negative effects of such the factor.

According to Table 4.19, ship operators are enforced by the regulation of LCP to implement 4 activities and encouraged by IMO to implement 3 activities.

4.5.3.3.1.1 Activities required by procedure of LCP

There are 4 activities that ship operators who need to deliver their ship-generated garbage at the GRF of LCP must abide by the procedure of LCP. These activities include 1) the routine communication when ship operators need to deliver their ship-generated garbage to the GRF of LCP such as telephone call and submission of notification form for the use of the GRF of LCP, etc. (R3A1), 2) the procedures for the use of GRF that are set up by LCP (R3A6), such as the first step is the telephone call by ship agent in order to notify their request to LCP and the second step is official submission of the notification form by fax machine or by hand, etc., 3) using the manual system for submitting the notification form from ship operators to LCP (R3A5), and 4) the advance submission (24 hours prior to the arrival of ship) of notification form for the use of garbage reception facility to LCP (R3B4).

It is noticed that 1) the routine communication between LCP and ship operators (R3A1) and 2) the procedures set up by LCP (R3A6) generate the overall positive impact on the collaborations between LCP and ship operators. Conversely, the overall effects of 1) the use of the manual system for submitting the notification form (R3A5) and 2) the advance submission of the notification form (R3B4) – are negative to the other activities implying that they obstruct the collaborations in the higher level. Fortunately, according to the interview with a Thai ship owner and two onboard practitioners, it is possible for LCP to improve the existing practices so as to solve the negative results from the mandatory activities above. For

example, according to results from the questionnaire survey, ship operators encourage LCP to replace the manual system for documentary exchange with paperless system in order to reduce paper cost and transactional activities, such as repeatedly filling in the notification form by ship agents for the use of GRF, which is claimed by the Thai ship owner as the non-value added activity. Using electronic documentary system enables them to dramatically complete the online notification form by using the history information from database. By doing this, the pessimistic outcome from manual system tends to be eliminated. Furthermore, the paperless system for documentary exchange can benefit the collaborations between LCP and the shipping firms through the seamless information flow, which supports the operational efficiency (Lam and Notteboom, 2014). However, it is emphasized by ship operators that the change of procedure for the use of GRF of LCP should not increase the transactional works or expenses to ship operators: otherwise, the replacement of manual system for documentary exchange by paperless system would be useless (Worawut Poma, **interview**, November 4, 2016).

4.5.3.3.1.2 Activities not required by procedure of LCP

It is optional for the shipping firms whether to 1) continuous improve the communication system of LCP (R3A3 and R3A7) or 2) try to reduce cost regarding the operation of ship-generated garbage (R3A4) because LCP does not force them to implement. However, this study urges them to conduct these activities because they support the collaborations between LCP and ship operators, which is the vital foundation of supply chain orientation in port (Song and Panayides, 2008; Tongzon, Chang and Lee, 2009; Yang et al., 2013; Ascencio et al. 2014). Besides, the above activities are also encouraged by IMO to implement in order to enhance the ability to prevent marine pollution (IMO, 2012). Thus, the activities that are not required by the procedure of LCP, but they are recommended to implement are 1) the continuous improvement of the communication system of LCP (R3A3) and 2) the continuous improvement of the communication system of the shipping firms (R3A7) and 3) keeping reducing cost regarding the operation of ship-generated garbage (R3A4).

4.5.3.3.2 Detail of COOP Model

COOP Model is the model guiding LCP and ship operators in what way to increase the collaborations in operating ship-generated garbage at the cooperative, coordinated and synchronized levels. Therefore, this model is created for 2 users - LCP and ship operators. The COOP Model for the implementation of LCP is presented in Figure 4.20 while that for the implementation of ship operators is shown in Figure 4.21.

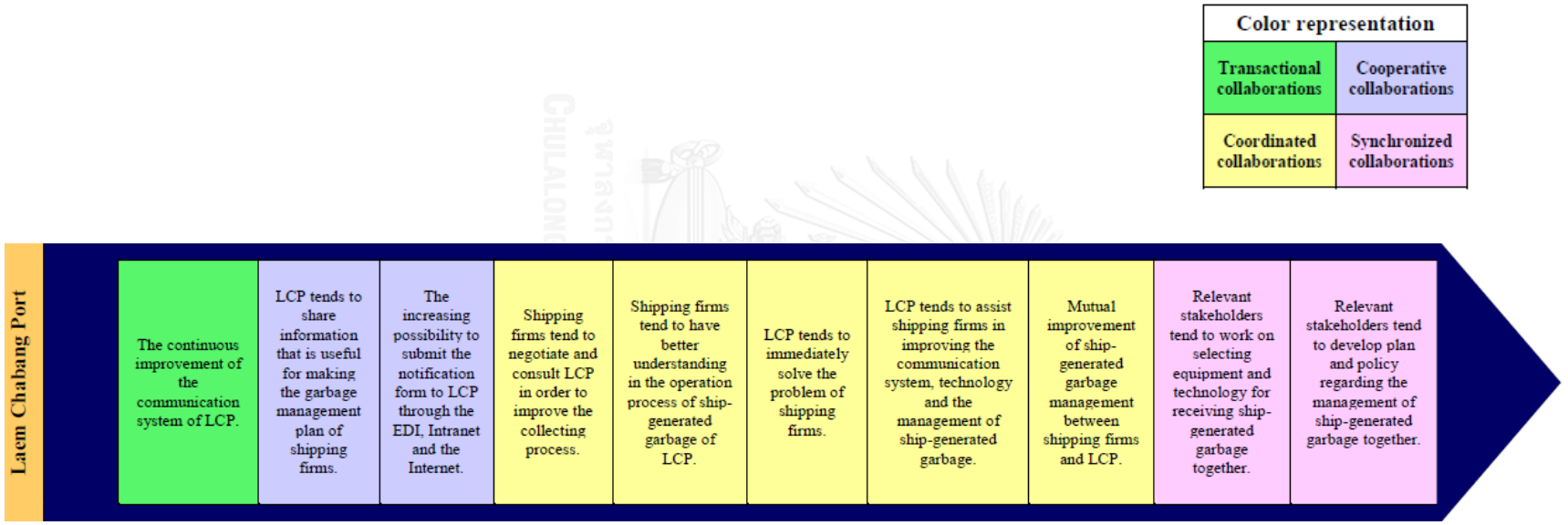

Figure 4.20 COOP Model for Laem Chabang Port to boost up the collaborations with ship operators in managing ship-generated garbage.

Remark

- The good practice is the activities that Laem Chabang Port should do in order to increase the probability to occur of the activities in the cooperative, coordinated and synchronized collaborations, which are in blue, buff and pink colors, respectively.
- The relationships of activities in the model are obtained from ordinal regression analysis.

Figure 4. 21 COOP Model for ship operators to boost up the collaborations with Laem Chabang Port in managing ship-generated garbage.

Remark - The good practice is the activities that Laem Chabang Port should do in order to increase the probability to occur of the activities in the cooperative, coordinated and synchronized collaborations, which are in blue, buff and pink colors, respectively.
- The relationships of activities in the model are obtained from ordinal regression analysis.

According to Figure 4.20, COOP Model guides LCP to continuously improve the communication system used in the operation of ship-generated garbage, which is the activity in transactional collaborations. Based on the results of ordinal regression analysis, performing this activity will increase the probability to occur of the activities in the cooperative, coordinated and synchronized collaborations in managing ship-generated garbage which are presented in blue, buff and pink colors respectively. Thus, LCP needs to continuously improve the communication system used in contacting with ship operators used in the operation of ship-generated garbage such as the 1) fax adopted for sending notification form, 2) telecommunication, 3) personnel included in communication with ship agents and others, 3) electronic mail for documentary exchange and 4) duration in processing service order during the day and so on. The continuous improvement of communication system will increase the possibility to occur of 2 activities in cooperative collaborations, 5 activities in coordinated collaborations and 2 activities in synchronized collaborations respectively.

In contrast, the COOP Model in Figure 4.21 provides two options for the shipping firms to implement - 1) the continuous improvement of the communication system of shipping firms and 2) the reduction of cost in the operation of ship-generated garbage. It is recommended to attain the first activity due to the higher priority prior to performing the activity with lower priority. By doing this, it will lead to the situation that increases the likelihood to take place of activities in the cooperative, coordinated and synchronized collaborations which are presented in blue, buff and pink colors respectively. Nevertheless, it should keep in mind that COOP Model can be valid as long as the present situation does not considerably change because the change in the significant factors such as 1) the operation in the GRF service provision of LCP, 2) the attitude of ship operators toward the delivery of ship-generated garbage at the GRF of LCP, 3) the technology in disposing garbage onboard, and 4) the regulations in Annex V of MARPOL 73/78, etc., can undermine the validity of this model. As a consequence, the framework should be adjusted accordingly to the change of the environment.

4.5.3.4 The expected benefits from the collaborations

This part aims to discuss the benefits expected to obtain from the implementation of COSERVE Model, COMARPOL Model and COOP Model in comparison with the theoretical benefits found in the previous literature, questionnaire survey and the interview of ship operators.

4.5.3.4.1 The benefits of COSERVE Model

Due to the fact that the COSERVE Model is designed to improve the performances in providing the GRF services that are not fulfilled by LCP, the main benefits that are expected to obtain from implementing COSERVE Model are **the fulfillment of LCP in ensuring the performances of GRF service in accordance with the regulations of MARPOL 73/78**. The collaboration frameworks are mainly expected to enable LCP to work with Laem Chabang Municipality and ship operators as **Ship-Generated Garbage Operation Committees (SGO Committees)** collaborating in solving and improving the existing problems such as 1) the

insufficiency of trip in collecting garbage from Laem Chabang Port to the landfill of Laem Chabang Municipality, 2) the misunderstanding of ship operators toward the rationality of the GRF service cost, and 3) the insufficient provision of information regarding GRF related services on the accessible sources. The success of SGO Committees is driven based on the weekly and monthly meetings involving all relevant stakeholders in 1) identifying the causes of the problem in operating GRF for receiving garbage from ships and 2) determining the sustainable solutions for alleviating the causes of the problems. In addition, this collaborations is expected to generate the good foundation for moving forward to collaborate in the higher level of collaborations or even green supply chain orientation.

4.5.3.4.2 The benefits of COMARPOL Model

The aims in developing COMARPOL Model are to enhance the ability of Marine Department of Thailand, as port state and flag state, in 1**) fulfilling its' legal obligations in accordance with the regulations of MARPOL 73/78, 2) exercising its' power through the national laws in the way that is consistent with international regulations, and 3) working with relevant partners in exploring in what way to increase the environmental standard in Thai seaports' operation through the legal collaborations**. Therefore, the benefits from the implementation of COMARPOL Model are the achievement of Marine Department in the aforementioned issues. The collaboration frameworks are expected to enable Marine Department to work with 1) Department of Industrial Works, 2) Laem Chabang Port, 3) ship operators, 4) educational institutes, and 5) companies registered by Marine Department as garbage treatment and disposal providers as **Ship-Generated Garbage Policy Planning Committees (SGPP Committees)**. The accomplishment of SGPP Committees is driven based on the monthly meetings involving all relevant stakeholders in 1) exploring the ways to enhance the legal enforcement of national laws, 2) identifying the challenge of legal incompliance of relevant operators, 3) determining the solutions for alleviating the legal incompliance and 4) updating the regulations of national laws regarding ship-generated garbage management and operation in accordance with the regulations in Annex V of MARPOL 73/78 and relevant regulations adopted by the International Maritime Organization.

4.5.3.4.3 The benefits of COOP Model

COOP Model is created in order to guide how to increase the cooperative, coordinated and synchronized collaborations by forming transactional collaborations between LCP and ship operators in operating ship-generated garbage. As a results, the benefits from the implementation of COOP Model are the increasing collaborations in the cooperative, coordinated and synchronized levels which are driven by three transactional activities - 1) the continuous improvement of the communication system of LCP, 2) the continuous improvement of the communication system of shipping firms, and 3) the attempt in reducing cost regarding the operation of ship-generated garbage. The expected collaborative activities from implementation of COOP Model are summarized in Table 4.20.

Table 4.20 Activities expected to occur from the implementation of COOP Model

Recommended activities to implement	Expected activities from implementation of COOP Model
The continuous improvement of the communication system of LCP.	1. LCP tends to share information that is useful for making the garbage management plan of shipping firms. 2. The increasing possibility to submit the notification form to LCP through the EDI, Intranet and the Internet. 3. Shipping firms tend to negotiate and consult LCP in order to improve the collecting process. 4. Shipping firms tend to have better understanding in the operation process of ship-generated garbage of LCP. 5. LCP tends to immediately solve the problem of shipping firms. 6. LCP tends to assist shipping firms in improving the communication system, technology and the management of ship-generated garbage. 7. Mutual improvement of ship-generated garbage management between shipping firms and LCP. 8. Relevant stakeholders tend to work on selecting equipment and technology for receiving ship-generated garbage together. 9. Relevant stakeholders tend to develop plan and policy regarding the management of ship-generated garbage together.
The continuous improvement of the communication system of shipping firms.	1. LCP tends to share information that is useful for making the garbage management plan of shipping firms. 2. Shipping firms tend to negotiate and consult LCP in order to improve the collecting process. 3. Shipping firms tend to have better understanding in the operation process of ship-generated garbage of LCP. 4. LCP tends to assist shipping firms in improving the communication system, technology and the management of ship-generated garbage. 5. Shipping firms and LCP tends to mutually develop the short course training, research and development project. 6. Shipping firms set up the garbage management plan corresponding with that of LCP. 7. Shipping firm, LCP and the other stakeholders tend to work on selecting equipment and technology for receiving ship-generated garbage together. 8. Shipping firm, LCP and the other stakeholders tend to develop plan and policy regarding the management of ship-generated garbage together.
Shipping firms try to reduce cost regarding the operation of ship-generated garbage.	1. LCP tends to share information that is useful for making the garbage management plan of shipping firms. 2. Shipping firms and LCP tend to mutually develop and design the document form regarding the garbage reception service. 3. Shipping firms tend to negotiate and consult LCP in order to improve the collecting process. 4. Shipping firms tend to have better understanding in the operation process of ship-generated garbage of LCP. 5. LCP tends to immediately solve the problem of shipping firms. 6. Shipping firm, LCP and the other stakeholders tend to work on selecting equipment and technology for receiving ship-generated garbage together.

Remark The activities that are expected to occur are obtained from the results of ordinal regression analysis.

CHAPTER V
CONCLUSION

The content in Chapter 5 is organized into 3 sections. The first section is the conclusion of the study briefly explaining the research background, objectives, methodology, findings and so on, while the second section is the short recommendations for policy implication which are drawn from the result discussions in Chapter 4. The final section is the suggestion for the future work.

5.1 Conclusion

Since the early 1970s, ship-generated garbage has been prioritized in the world agenda as the substantial cause of marine pollution (Waldichuk, 1973). Initially, different means for dealing with the negative externality generated from the ship-generated garbage were dissimilarly implemented from country to country (IMO, 2015). Thereinafter, the implementation was standardized by the regulations of MARPOL 73/78 which was adopted by (IMO) in 1973 and then enforced in 1978 (IMO, 2011, 2015). However, many academic evidences pointed out the drawback of MARPOL convention in controlling the misconduct of ship. At the same time, the growing number of ship-generated garbage accumulated in marine environment, such as plastic garbage, metal cans, glass, rags, batteries and small containers etc. was reported in many studies. This marine debris was proved by several scholars as one of the major causes of the entanglement of aquatic wildlife (Vauk and Schrey, 1987; Henderson, 2001; Gall and Thompson, 2015) and threat to marine ecosystem that can lead to the loss of marine biology (Laist, 1987; Phillips, 2015). Therefore, the measures and regulations for preventing marine pollution from ship-generated garbage are heavily placed on the management and operation in seaports.

Legally, seaports are required by the regulation of MARPOL 73/78 to ensure the adequacy of the garbage reception facility (GRF) for receiving the entire amount of garbage from ship without delay to the routine operation of ship (IMO, 2000, 2012, 2013). However, ensuring an adequacy of GRF is not a simple task as its success depends on many factors (Olson, 1994). Hence, the other tools for garbage management in ports were recommended by many scholars, such as education (Cho, 2009), incentive price (Georgakellos, 2007), penalty and reward (Lam and Notteboom, 2014) etc. Unfortunately, the aforementioned tools seem to be popular in fishery industry rather than maritime transportation. This points out the gap in the previous study. Moreover, the modern role of seaports as the strategic partners in supply chain shades light to the need for port authority to include the parameters regarding logistics, supply chain and competiveness into account (Song and Panayides 2008; Tongzon, Chang and Lee 2009).

Therefore, this study adds value to the literature through 4 research objectives – 1) to survey the levels of existing performance of the provision of garbage reception facility (GRF) of Laem Chabang Port (LCP) from the shipping firms' perspective based on the regulations of Annex V in MARPOL 73/78, 2) to analyze the factors that affect the motivation of the shipping companies to deliver their ship-generated garbage to the

GRF of LCP, 3) to analyze the relationship of maritime collaborations between LCP and the shipping companies in ship-generated garbage management and 4) to analyze the benefits gained from green shipping collaborations between LCP and the shipping companies in ship-generated garbage management. By using the questionnaire survey to 148 shipping firms using the GRF of LCP, the author received the complete questionnaire from 127 shipping firms with the response rate of 85.81%. Initially, the reliability of data is tested by using Cronbach's alpha while the difference of data from the position of respondents is investigated by using t-test. To attain the research objectives and hypothesis, the data for objective 1, 2 and 4 is analyzed by using the multivariate analysis of variance (MANOVA) whereas the that of objective 3 is analyzed by using ordinal regression analysis.

According to the findings of the first research objective, it is found that the 1) levels of transactional collaborations (high, moderate and low frequency) of the shipping firms with LCP, 2) nationality of the shipping firms and 3) types of ships have the influence on the differences of the evaluated score of the performance of LCP in providing the garbage reception facility (GRF). Overall, the provision of the GRF by LCP is well performed in term of the physical adequacy, GRF service price and easy procedure for the use of GRF. However, a few points that LCP should improve which are the availability of the GRF service, including the sorting shed, labors at the sorting shed and the collecting truck. Besides, the information regarding the GRF related service and the location of the GRF service center, etc., is insufficiently shared to the ship agents. Thus, distributing information through the efficient channels such as people channel and the online channel, etc., seem to be the good way to solve this challenge.

Corresponding to the results of the second research objective, it is explored the 1) levels of transactional collaborations (high, moderate and low frequency) of the shipping firms with LCP, 2) nationality of the shipping firms and 3) types of ships influence the motivations of the shipping firms in delivering their ship-generated garbage at the GRF of LCP. Generally, the delivery of ship-generated garbage of the shipping firms depends on a few factors. The first dominant factor is the international law such as the regulations of MARPOL 73/78 etc. while the adequacy of GRF in receiving the entire amount of garbage is another factor playing on the disposal at LCP’s facilities. Another vital reason is the efficiency of the GRF related operation, which should not aggravate any delay to the routine operations of ship. The ease of procedure for the use of the GRF as well as the service charging fee also play the critical role on their decision. Therefore, it is recommended for LCP and relevant parties to improve the operational efficiency in providing GRF in order to avoid the delay to the regular operation of ship. Further, it is suggested for Marine Department, as the representative of Thai governmental agency, to ratify the extended regulations of MARPOL 73/78 so as to enhance the legal enforcement on the delivery of garbage at the GRF of LCP.

For the third research objective, the findings indicate that the transactional collaborations, as the routine tasks, are the vital foundation of all levels of collaborations between LCP and the shipping lines in managing ship-generated garbage. The coordinated collaborations depends heavily on transactional collaboration rather than on cooperative collaborations, while the cooperative collaborations themselves rely solely on the transactional collaborations. For the highest type of collaboration, the synchronized collaborations scarcely depend on other types of

collaborations. This pointed out the weak point in the collaborative structure between LCP and ship operators. Therefore, it is recommended for LCP to focus on performing the activities that positively associate with the other collaborative activities so as to support the orientation of supply chain management in ports. For example, the continuous improvement of the communication process used by LCP in contacting with ship operators has the highest impact on collaborations. Twelve collaborative activities depend on its existence and so on. Conversely, the activities that have negative effects on the other collaborative activities are suggested to avoid, such as the information sharing by LCP to the shipping firms, etc. It is found that the transactional information can be still shared among them but the strategic information sharing seems to decrease their intention to develop the higher collaborations. By doing this, the cooperative, coordinated and synchronized collaborations can be developed and solidified. Otherwise, the collaborations, especially the synchronized collaborations, will be gradually undermined which results in the lower logistics and supply chain performances.

For last research objective, the findings indicate that the 1) levels of transactional collaborations (high, moderate and low frequency) of the shipping firms with LCP, 2) nationality of the shipping firms and 3) types of ships dominate the differences of benefits that ship operators expect to gain from the collaborations with LCP in managing ship-generated garbage. If LCP demands to collaborate with ship operators, such the collaborative project should financially benefit them such as 1) the continuous improvement of communication system which can reduce cost and time in transferring garbage from ship to reception facility, 2) the development of advance submission of notification form for the use of the GRF of LCP which can enhance ship operators' and LCP's garbage management plan and operation, 3) the projects that can increase the operational efficiency in providing the GRF service and can reduce the delay to the routine operation of ship, and 4) the project that enables them to use the same database and information technology in ship-generated garbage management which can increase their and LCP's accuracy of garbage management plan. By developing the above collaborative projects with ship operators, LCP tends to succeed due to the full assistance from the shipping lines in accomplishing their goals.

5.2 Recommendations

This section aims to recommend how to adopt COSERVE Model, COMARPOL Model and COOP Model for improving the management and operation of ship-generated garbage in LCP. The recommendations are based on the existing operation of ship-generated garbage of LCP divided into 3 parts – 1) the provision of GRF by the staffs of LCP and LCM, 2) the administration and control by external regulators and partners participating the operation of ship-generated garbage, and 3) the collaborations between LCP and ship operators. Each part is represented by red, green and blue color, respectively, as presented in Figure 5.1.

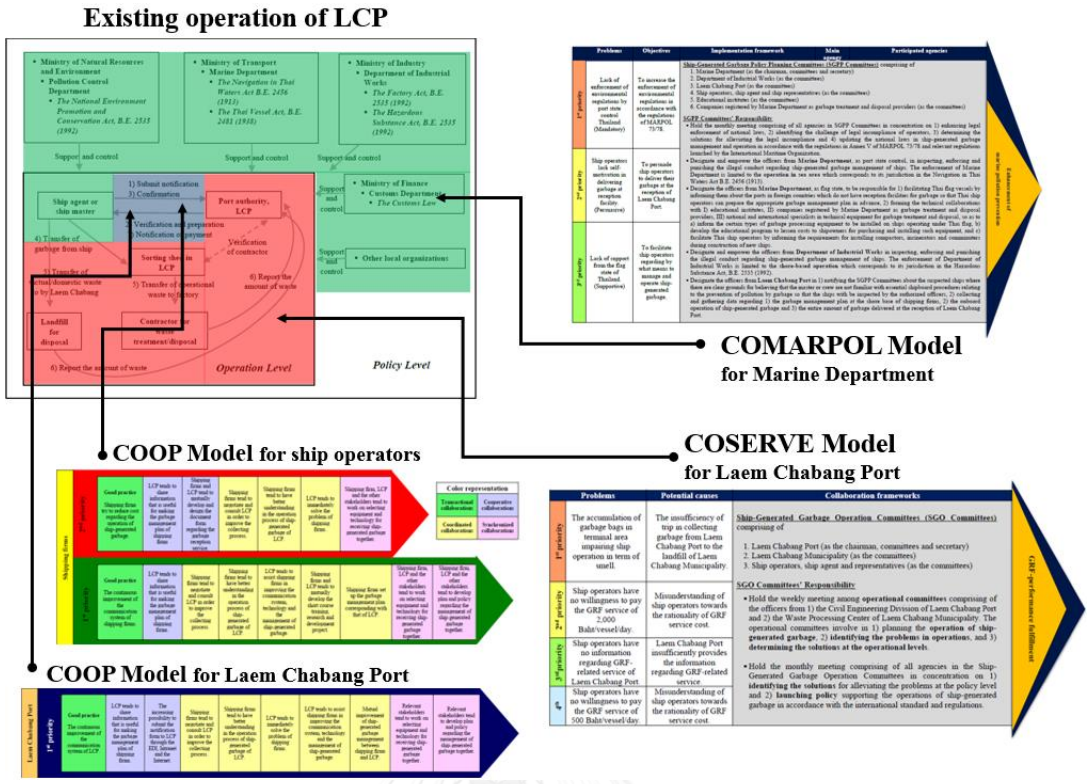

Figure 5.1 The adoption of COSERVE Model, COMARPOL Model and COOP Model in improving different parts of the existing GRF-operation of LCP

Corresponding with Figure 5.1, LCP and relevant government agencies are recommended to adopt 3 models developed in this study in improving the operation of ship-generated garbage. Firstly, the red part covers the provision of GRF service of Laem Chabang Port, Laem Chabang Municipality and other operators. In this part, the performances required by the regulations of MARPOL convention but not fulfilled by LCP can be improved by adopting the collaboration framework in COSERVE Model. Secondly, the green part covers the administration and legal control of Thai governmental regulators. The obligations of port state and flag state required by the regulations of MARPOL convention and encouraged by the IMO, but not fully implemented by Marine Department and other agencies can be solved by adopting the collaboration frameworks in COMARPOL Model. Finally, the blue part represents the collaborations between Laem Chabang Port (as GRF provider) and ship operators (as GRF user), claimed by IMO as the critical factors on the success of the utilization of the GRF and marine pollution prevention. To increase the collaborations between them, LCP and ship operators are recommended to adopt the collaboration frameworks in COOP Model.

5.3 Future study

5.3.1 Expansion of the scope of study

This study concentrates only on garbage generated from ships described in the Annex V of MARPOL 73/78 (IMO, 2002). In reality, there are other types of waste

from ships that are dangerous and harmful to marine environment and human including oil (Annex I), noxious liquid substances (Annex II), harmful substances in packaged form (Annex III), sewage from ships (Annex IV) and air pollution from ships (Annex VI). Therefore, the future study should extend their scope of study to other types of waste so as to fill in the gap in the previous literature. Furthermore, this study focuses mainly on the external collaborations between seaports and the shipping firms. Thus, the internal collaborations should be further analyzed in future research.

5.3.2 Balancing the interests from different points of view

Despite of the fact that the waste from maritime transportation is not a popular issue among the majority of scholars and its operation is not considered as the value added activities by shipping firms. Some researchers have already proved that the operation of ship-generated garbage is integrated with other port operations. This means that the inefficiency of garbage-related activities can impair the overall logistics and supply chain performances. Therefore, it is recommended for future studies to take garbage-related activities into account when ports logistics and supply chain are in consideration. Apart from the legal parameters, the other parameters regarding logistics, supply chain and competitiveness should be added into the study in order to balance the interest from the environmental, legal and commercial perspectives.

REFERENCES

Anastasiadou, S. D. Reliability and validity testing of as new scale for measuring attitudes toward learning statistics with technology. **Acta Didactica Napocensia** 4 (2011) : 1-10.

Ascencio, L.M., González-Ramírez, R.G. , Bearzotti, L.A., Smith, N.R. and Camacho-Vallejo, J.F. A Collaborative Supply Chain Management System for a Maritime Port Logistics Chain. **Journal of Applied Research and Technology** 2 (2014) : 444-458.

Australian Maritime Safety Authority. **IMO Documentation** [Online].(28 August 2015). Available from: https://imo.amsa.gov.au/public/parties/marpol78.html [15 July 2016].

Ball, I. Port waste reception facilities in UK ports. **Marine Policy** 23 (1999) : 307-327.

Bateman, S. Environmental issues with Australian ports. **Ocean & Coastal Management** 33 (1996) : 229-247.

Board of Investment of Thailand . **Infrastructure** [Online]. November 2015. Available from: http://www.boi.go.th/index.php?page=seaports [7 May 2016].

Boonlert Nomsin, Mayor, Laem Chabang Municipality. **Interview**, 3 October 2007.

Butt, N. The impact of cruise ship generated waste on home ports and ports of call: A study of Southampton. **Marine Policy** 31 (2007) : 591-598.

Carpenter, A., and Macgill, S. M. The EU Directive on port reception facilities for ship-generated waste and cargo residues: The results of a second survey on the provision and uptake of facilities in North Sea ports. **Marine Pollution Bulletin** 50 (2005) : 1541–1547.

Chalermpong Senarak. The econometric model of ship-generated operational waste: the underlying tool for waste management in container port. **Applied Environmental Research** 38 (2016) : 19-31.

Chang, Y. Environmental efficiency of ports: a Data Envelopment Analysis approach. **Maritime Policy & Management: The flagship journal of international shipping and port research** 40 (2013) : 467-478.

Chen, C. L., and Liu , T. K. Fill the gap : Developing management strategies to control garbage pollution from fishing vessels. **Marine Policy** 40 (2013) : 34–40.

Cho, D. O. The incentive program for fishermen to collect marine debris in Korea. **Marine Pollution Bulletin** 58 (2009) : 415–417.

Civil Engineering Division, Laem Chabang Port. **Interview**, January 15, 2015.

Clott, C., and Hartman, B. C. Supply chain integration, landside operations and port accessibility in metropolitan Chicago. **Journal of Transport Geography** 51 (2016) : 130–139.

Cohen, S., and Roussel, J. *Strategic Supply Chain Management.* USA: McGraw-Hill, 2005.

Davarzani, H., Behnam, F., Bell, M. and Sarkis, J. Greening ports and maritime logistics: A review. **Transportation Research Part D**, 2015.

Deming, W. E. *Sample design in business research*. New York: John Wiley & Sons, 1990.

Derraik, J. G. B. The pollution of the marine environment by plastic debris: a review. **Marine Pollution Bulletin** 44 (2002) : 842–852.

Gall, S.C., and Thompson, R.C. The impact of debris on marine life. **Marine Pollution Bulletin** 92 (2015) : 170–179.

Georgakellos, D. A. The use of the deposit–refund framework in port reception facilities charging systems. **Marine Pollution Bulletin** 54 (2007): 508–520.

Gibbs, D., Patrick, R. M., Mangan, J., and Lalwani, C. The role of sea ports in end-to-end maritime transport chain emissions. **Energy Policy** 64 (2014) : 337–348.

Hall, P. V., Thomas O. B., and Woudsma, C. Environmental innovation and the role of stakeholder collaborations inWest Coast port gateways. **Research in Transportation Economics** 42 (2013) : 87-96.

Henderson, J. R. A Pre - and Post - MARPOL Annex V Summary of Hawaiian Monk Seal Entanglements and Marine Debris Accumulation in the Northwestern Hawaiian Islands, 1982-1998. **Marine Pollution Bulletin** 42 (2001) : 584-589.

Hinojosa, I. A., and Thiel, M. Floating marine debris in fjords, gulfs and channels of southern Chile. **Marine Pollution Bulletin** 58 (2009) : 341–350.

Horsman, P. V. The Amount of Garbage Pollution from Merchant Ships. **Marine Pollution Bulletin** 13 (1982) : 167-169.

Hoshino, H. Competition and Collaborations among Container Ports. **The Asian Journal of Shipping and Logistics** 26 (June 2010) : 31-48.

Hudnurkar, M., Suresh, J., and Urvashi, R. Factors affecting collaborations in supply chain: A literature Review. **Social and Behavioral Sciences** 133 (2014) : 189-202.

International Maritime Organization. **Guide to Good Practice for Port Reception Facility Providers and Users** [Online]. (1 July 2013). Available from: http://www.imo.org/en/OurWork/Environment/PortReceptionFacilities/Docu

ments/MEPC.1-Circ.834%20-%20Consolidated%20Guidance%20For%20Port%20Reception%20Facility%20Providers%20And%20Users%20(Secretariat)%20(1).pdf [15 August 2015].

International Maritime Organization. **GUIDELINES FOR ENSURING THE ADEQUACY OF PORT WASTE RECEPTION FACILITIES** [Online]. (13 March 2000). Available from: www.imo.org/pages/home.aspx [10 June 2015].

International Maritime Organization. **History of MARPOL (International Convention for the Prevention of Pollution from Ships)** [Online]. (n.d.). Available from: http://www.imo.org/en/KnowledgeCentre/ReferencesAndArchives/HistoryofMARPOL/Pages/default.aspx [5 May 2016].

International Maritime Organization. **MARPOL Consolidated Edition 2011** [Online]. (2011). Available from: http://www.imo.org/en/Publications/Documents/Supplements%20and%20CDs/English/QD520E_092015.pdf. [4 June 2015]

International Maritime Organization. **LIST OF CONVENTIONS, OTHER MULTILATERAL INSTRUMENTS AND AMENDMENTS IN RESPECT OF WHICH THE ORGANIZATION PERFORMS DEPOSITARY AND OTHER FUNCTIONS.** [Online] (31 May 2016). Available from: http://www.imo.org/en/About/Conventions/StatusOfConventions/Pages/Default.aspx [23 July 2016].

International Maritime Organization. **The International Convention for the Prevention of Pollution from Ships (MARPOL)** [Online]. (2015). Available from: https://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-%28MARPOL%29.aspx [5 June 2016].

Jaccoud, C., and Magrini, A. Regulation of solid waste management at Brazilian ports: Analysis and proposals for Brazil in light of the European experience. **Marine Pollution Bulletin** 79 (2014) : 245–253.

Jones, M. M. Fishing Debris in the Australian Marine Environment. **Marine Pollution Bulletin** 30 (1995) : 25-33.

Khuntong Soontree, Krirk Wongsorntam, Sarawut Thepanondh, and Panya Khaenamkaew. Effect of Particulate Matters from Shipping Activities around Si Racha Bay – Si Chang Island. **EnvironmentAsia** 3 (2010) : 59-68.

Knapp, S., and Franses, P. H. Does ratification matter and do major conventions improve safety and decrease pollution in shipping?. **Marine Policy** 33 (2009) : 826–846.

Laem Chabang Port. **Information** [Onilne]. 2013. Available from: http://laemchabangport.com/index.php [7 May 2016].

Lai, K., and Lam, J. S. L. Developing environmental sustainability by ANP-QFD approach: the case of shipping operations. **Journal of Cleaner Production** 105 (2015) : 275-284.

Lai, K., Venus, Y. H. L., Wong, C. W. Y., and Cheng, T.C.E. Green shipping practices in the shipping industry: Conceptualization, adoption, and implications. **Resources, Conservation and Recycling** 55 (2011) : 631–638 .

Lai, K., Wong, C. W. Y., and Lam, J. S. L. Sharing environmental management information with supply chain partners and the performance contingencies on environmental munificence. **International journal of Production Economics** (2014) *(In press).*

Laist, D. W. Overview of the Biological Effects of Lost and Discarded Plastic Debris in the Marine Environment. **Marine Pollution Bulletin** 18 (1987) : 319-326.

Lam, J. S. L., and Notteboom, T. The Greening of Ports: A Comparison of Port Management Tools Used by Leading Ports in Asia and Europe. **Transport Reviews: A Transnational Transdisciplinary Journal** 32 (2014) : 169-189.

Lam, J. S. L., and Voorde, E. V. D. Scenario analysis for supply chain integration in container shipping. **Maritime Policy & Management: The flagship journal of international shipping and port research** 38 (2011) : 705-725.

Lam, J. S. L., and Yap, W Y. Dynamics of liner shipping network and port connectivity in supply chain systems: analysis on East Asia. **Journal of Transport Geography** 19 (2011) : 1272–1281.

Lam, J. S. L., Ng, A. K. Y., and Fu, X. Stakeholder management for establishing sustainable regional port governance. **Research in Transportation Business & Management** 8 (2013) : 30–38.

Lam, J. S. L. Patterns of maritime supply chains: slot capacity analysis. **Journal of Transport Geography** 19 (2011) : 366–374.

Leonie, C. E. S., and Vis, I. F. A.. Port supply chain integration: analyzing biofuel supply chains . **Maritime Policy & Management** 43 (2016) : 261-279.

Li, L., Wang, B., and Cook, D. P. Reprint of "Enhancing green supply chain initiatives via empty container reuse. **Transportation Research Part E** 74 (2015) : 109–123.

Loh, H. S., and Thai, V. V. Cost Consequences of a Port-Related Supply Chain Disruption . **The Asia Journal of Shipping and Logistics** 31 (2015) : 319-340.

Marine Department. **Port Waste Management in Thai Ports Project** [Online]. (2008). Available from: oldweb.md.go.th/safety_environment/04_3_pdf/PDF-Exe/Executive-Eng.pdf [10 May 2015].

Ministry of Transport. **Sea transport statistics** [Online]. (2014). Available from: http://vigportal.mot.go.th/portal/site/PortalMOT/stat/index26URL/ [14 August 2015].

Mueller, F., Cannata, A., and Herrmann, C. Procedure of modular Green Factory Planning to enhance collaborations and decision making. **CIRP** 15 (2014) : 331-336.

Ng, A. K. Y., and Song, S. The environmental impacts of pollutants generated by routine shipping operations on ports. **Ocean & Coastal Management** 53 (2010) : 301-311.

Olson, P. H. Handling of Waste in Ports. **Marine Pollution Bulletin** 29 (1994) : 284-295.

Pallant, J. *SPSS SURVIVAL MANUAL - A step by step guide to data analysis using SPSS for Windows (Version 12)*. Australia: Allen & Unwin, 2002.

Panayides, P. M., and Lun, Y. H. V. The impact of trust on innovativeness and supply chain performance. **Iternational Journal of Production Economics** 122 (2009) : 35-46.

Parola, F., Satta, G., and Caschili, S. Unveiling co-operative networks and 'hidden families' in the container port industry. **Maritime Policy & Management: The flagship journal of international shipping and port research** 41 (2014) : 384-404.

Phillips, W.N. Tourism Threats to Coral Reef Resilience at Koh Sak, Pattaya Bay. **Environment and Natural Resources** 13 (2015) : 47-60.

Plambeck, E. L. Reducing greenhouse gas emissions through operations and supply chain management. **Energy Economics** 34 (2012) : S64–S74.

Polglaze, J. Can we always ignore ship-generated food waste?. **Marine Pollution Bulletin** 46 (2003) : 33-38.

Pollution Control Department. **Thailand State of Pollution Report** [Online]. 2013. Available from: http://www.pcd.go.th/indexEng.cfm [18 July 2015].

Port Authority of Thailand. **PAT NEWS**. (2013) : 6-10.

Rees, G., and Pond, K. Marine Litter Monitoring Programmes-A Review of Methods with Special Reference to National Surveys. **Marine Pollution Bulletin** 30 (1995) : 103-108.

Rodrigues, V. S., Pettit, S., Harris, I., Beresford, A., Piecyk, M., Yang, Z. and Ng, A. UK supply chain carbon mitigation strategies using alternative ports and multimodal freight transport operations. **Transportation Research Part E** 78 (2015) : 40–56.

Song, D. P., Lyons, A., Li, L. D., and Sharifi, H. Modeling port competition from a transport chain perspective. **Transportation Research Part E** 87 (2016) : 75–96.

Song, D. W., and Panayides, P. M. Global supply chain and port/terminal: integration and competitiveness. **Maritime Policy & Management: The flagship journal of international shipping and port research** 35 (2008) : 73-87.

Tabachnick, B. G. and Fidell, L. S. *Using multivariate statistics*. New York: Harper & Row. 1983.

Talley, W. K., Ng, M. W. and Marsillac, E. Port service chains and port performance evaluation. **Transportation Research Part E** 69 (2014) : 236–247.

Tongzon, J., Chang, Y. T., and Lee, S. Y. How supply chain oriented is the port sector?. **International journal of Production Economics** 122 (2009) : 21-34.

Tovar, B., Hernández, R. and Héctor R. D. Container port competitiveness and connectivity: The Canary Islands main ports case. **Transport Policy** 38 (2015) : 40–51.

Ulnikovic, V. P., Vukic, M. and Nikolic, R. Assessment of vessel-generated waste quantities on the inland waterways of the Republic of Serbia. **Journal of Environmental Management** 97 (2012) : 97-101.

Vauk, G. J. M., and Schrey, E. Litter Pollution from Ships in the German Bight. **Marine Pollution Bulletin** 18 (1987) : 316-319.

Vieira, G. B. B., Neto, F. J. K. and Ribeiro, J. L. D. The Rationalization of Port Logistics Activities: A Study at Port of Santos (Brazil). **International Journal of e-Navigation and Maritime Economy** 2 (2015) : 73-86.

Waldichuk, M. International Approach to the Marine Pollution Problem. **Ocean Management** 1 (1973) : 211-261.

Wang, J. J., and Cheng, M. C. From a hub port city to a global supply chain management center: a case study of Hong Kong. **Journal of Transport Geography** 18 (2010) : 104–115.

Yang, C. S., Lu, C. S., Haider, J. J., and Marlow, P. B. The effect of green supply chain management on green performance and firm competitiveness in the context of container shipping in Taiwan. **Transportation Research Part E** 55 (2013) : 55–73.

Zhang, L., and Lam, J. S. L. Enhanced logistics service provider framework for higher integration and efficiency in maritime logistics. **International Journal of Logistics Research and Applications: A Leading Journal of Supply Chain Management** 17 (2014) : 89-113.

APPENDIX

APPENDIX A

RESPONSE BIAS, DIFFERENCES AND RELIABILITY OF DATA

A.1 Response bias

Corresponding with 4.1, the response bias, which can occur in the questionnaire survey, was initially minimized by systematically develop the questionnaire. The content in the questionnaire was ensured by intensive literature review in order to make the questionnaire to cover all related contents. Afterwards, the content was validated by 3 experts – 2 experts from Marine Department and 1 expert from Port Authority of Thailand. The layout of the questionnaire was well organized and the statements included in the questionnaire were carefully composed with an understandable vocabularies so as to make it easier for the respondents to understand the questionnaire. In addition, before completing the questionnaire, the respondents was given a clear explanation relating to the major contribution of their information to the current literature and society as well as ensuring that respondent information will be kept confidential. By adopting these measures which are widely implemented by many scholars, it is believed that the response bias can be relieved.

A.2 Test of difference of score

According to the questionnaire survey, the respondents can be classified into 2 main groups – 1) onboard officers and 2) onshore officers. Due to the different experience and work environment, the scores evaluated by them are expected to differ in some topics. Therefore, their scores are investigated based on the research objectives by using t-test. Based on the test results, the positions of the respondents – onboard and shore base officers – dominate on the score of attribution R2B1 and R2B7 implying the difference of the score. In order to deal with this problem, the respondent-position will be treated as the independent variable in an analysis.

A.3 Reliability testing

The reliability of attributions in part 2 – part 4 of questionnaire was tested by using Cronbach's Alpha. Corresponding with test results, the values of Cronbach's Alpha of the questionnaire part 2, 3 and 4 are greater than .7 after excluding the inhomogeneous attributions from the questionnaire. This includes the attribution R1A2, R1D5, R1E3 and R1F2 from the questionnaire part 2 and R2A6 from the questionnaire part 3. However, the Cronbach's Alpha identifies the attributions that measure the thing that are not measured by the majority of attributions. This implies that the excluded attributions are still beneficial but they should be analyzed separately from the other major attributions so as to avoid the occurrence of statistical problem. These 5 attributions are analyzed separately (Anastasiadou, 2011).

APPENDIX B

RESULT OF MANOVA FOR RESEARCH OBJECTIVE 1

Table B1 Post hoc test (ship type) the 3rd round of MANOVA for objective 1

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
						Lower Bound	Upper Bound
R1A1	General Cargo	Container Ship	0.247	0.1407	0.412	-0.344	0.837
		Bulk Carrier	0.17	0.2258	0.941	-0.882	1.222
		Vehicles Carrier/RoRo	1.385	0.5131	0.427	-364.827	367.596
	Container Ship	Bulk Carrier	-0.076	0.2101	0.996	-1.106	0.953
		Vehicles Carrier/RoRo	1.138	0.5064	0.511	-508.137	510.413
	Bulk Carrier	Vehicles Carrier/RoRo	1.214	0.5364	0.471	-146.727	149.156
R1A3	General Cargo	Container Ship	-0.617	0.2385	0.089	-1.619	0.385
		Bulk Carrier	0.181	0.3206	0.979	-1.256	1.619
		Vehicles Carrier/RoRo	-1.462	0.537	0.388	-145.473	142.55
	Container Ship	Bulk Carrier	0.798	0.2878	0.076	-0.558	2.154
		Vehicles Carrier/RoRo	-0.845	0.5182	0.642	-294.191	292.502
	Bulk Carrier	Vehicles Carrier/RoRo	-1.643	0.5607	0.325	-73.61	70.325
R1A4	General Cargo	Container Ship	-0.109	0.1863	0.977	-0.901	0.684
		Bulk Carrier	-0.099	0.2675	0.996	-1.304	1.106
		Vehicles Carrier/RoRo	-0.385	0.525	0.925	-222.82	222.051
	Container Ship	Bulk Carrier	0.01	0.2346	1.000	-1.128	1.148
		Vehicles Carrier/RoRo	-0.276	0.509	0.968	-446.092	445.541
	Bulk Carrier	Vehicles Carrier/RoRo	-0.286	0.544	0.973	-115.868	115.297
R1B1	General Cargo	Container Ship	-0.125	0.2217	0.980	-1.073	0.823
		Bulk Carrier	-0.181	0.2971	0.972	-1.496	1.133
		Vehicles Carrier/RoRo	-1.038	0.5363	0.545	-148.584	146.507
	Container Ship	Bulk Carrier	-0.057	0.2493	0.999	-1.253	1.14
		Vehicles Carrier/RoRo	-0.914	0.5114	0.606	-398.275	396.447
	Bulk Carrier	Vehicles Carrier/RoRo	-0.857	0.5483	0.643	-102.288	100.574
R1B2	General Cargo	Container Ship	-0.501	0.2069	0.124	-1.364	0.361
		Bulk Carrier	-0.56	0.2746	0.275	-1.799	0.678
		Vehicles Carrier/RoRo	-1.346	0.5261	0.430	-214.805	212.113
	Container Ship	Bulk Carrier	-0.059	0.2544	0.999	-1.243	1.125
		Vehicles Carrier/RoRo	-0.845	0.5158	0.641	-325.452	323.762
	Bulk Carrier	Vehicles Carrier/RoRo	-0.786	0.5465	0.686	-107.797	106.225
R1B3	General Cargo	Container Ship	0.156	0.1467	0.823	-0.464	0.777
		Bulk Carrier	0.06	0.23	0.999	-1	1.121
		Vehicles Carrier/RoRo	-0.154	0.515	0.996	-337.094	336.786
	Container Ship	Bulk Carrier	-0.096	0.2098	0.990	-1.126	0.934
		Vehicles Carrier/RoRo	-0.31	0.5063	0.953	-513.51	512.89
	Bulk Carrier	Vehicles Carrier/RoRo	-0.214	0.5364	0.989	-148.156	147.727
R1C1	General Cargo	Container Ship	0.479	0.1392	0.010***	-0.106	1.063
		Bulk Carrier	0.176	0.1695	0.836	-0.57	0.921
		Vehicles Carrier/RoRo	-0.038	0.5129	1.000	-371.147	371.07
	Container Ship	Bulk Carrier	-0.303	0.1485	0.277	-0.982	0.376
		Vehicles Carrier/RoRo	-0.517	0.5063	0.836	-513.154	512.119
	Bulk Carrier	Vehicles Carrier/RoRo	-0.214	0.5155	0.987	-330.383	329.954
R1C2	General Cargo	Container Ship	-0.015	0.1461	1.000	-0.63	0.6
		Bulk Carrier	0.049	0.2081	0.999	-0.894	0.993
		Vehicles Carrier/RoRo	-0.808	0.5145	0.661	-345.636	344.021
	Container Ship	Bulk Carrier	0.064	0.1879	0.997	-0.836	0.964
		Vehicles Carrier/RoRo	-0.793	0.5066	0.668	-505.09	503.504
	Bulk Carrier	Vehicles Carrier/RoRo	-0.857	0.5279	0.637	-200.713	198.999
R1C3	General Cargo	Container Ship	-.958	0.2236	0.001***	-1.907	-0.008
		Bulk Carrier	0.148	0.3282	0.991	-1.338	1.635
		Vehicles Carrier/RoRo	-1.423	0.5354	0.401	-153.486	150.639
	Container Ship	Bulk Carrier	1.106	0.2904	0.010***	-0.309	2.52
		Vehicles Carrier/RoRo	-0.466	0.5131	0.872	-366.95	366.019
	Bulk Carrier	Vehicles Carrier/RoRo	-1.571	0.5666	0.341	-63.595	60.452

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
						Lower Bound	Upper Bound
R1D1	General Cargo	Container Ship	-0.118	0.161	0.948	-0.799	0.563
		Bulk Carrier	-0.165	0.263	0.969	-1.387	1.057
		Vehicles Carrier/RoRo	1.192	1.0092	0.784	-1123.93	1126.315
	Container Ship	Bulk Carrier	-0.047	0.2409	1.000	-1.24	1.146
		Vehicles Carrier/RoRo	1.31	1.0037	0.746	-1324.202	1326.823
	Bulk Carrier	Vehicles Carrier/RoRo	1.357	1.025	0.736	-753.499	756.213
R1D2	General Cargo	Container Ship	-0.279	0.1718	0.490	-0.986	0.429
		Bulk Carrier	-0.407	0.1685	0.135	-1.138	0.324
		Vehicles Carrier/RoRo	-0.192	1.0077	0.999	-1175.234	1174.849
	Container Ship	Bulk Carrier	-0.128	0.1644	0.935	-0.826	0.569
		Vehicles Carrier/RoRo	0.086	1.007	1.000	-1198.131	1198.303
	Bulk Carrier	Vehicles Carrier/RoRo	0.214	1.0065	0.999	-1218.115	1218.543
R1D3	General Cargo	Container Ship	-0.203	0.1877	0.816	-0.977	0.571
		Bulk Carrier	-0.176	0.2384	0.946	-1.257	0.905
		Vehicles Carrier/RoRo	-0.462	1.0095	0.981	-1115.472	1114.549
	Container Ship	Bulk Carrier	0.027	0.2318	1.000	-1.028	1.083
		Vehicles Carrier/RoRo	-0.259	1.008	0.998	-1164.828	1164.311
	Bulk Carrier	Vehicles Carrier/RoRo	-0.286	1.0187	0.997	-878.652	878.081
R1D4	General Cargo	Container Ship	-0.379	0.249	0.552	-1.422	0.664
		Bulk Carrier	-0.071	0.3218	0.999	-1.507	1.364
		Vehicles Carrier/RoRo	-1.000	1.5135	0.942	-1698.142	1696.142
	Container Ship	Bulk Carrier	0.308	0.2899	0.824	-1.039	1.654
		Vehicles Carrier/RoRo	-0.621	1.5071	0.986	-1926.89	1925.649
	Bulk Carrier	Vehicles Carrier/RoRo	-0.929	1.5208	0.954	-1489.559	1487.702
R1E1	General Cargo	Container Ship	-0.386	0.1384	0.053	-0.958	0.187
		Bulk Carrier	-0.159	0.2019	0.931	-1.097	0.779
		Vehicles Carrier/RoRo	-.731	0.1046	0.000***	-1.208	-0.253
	Container Ship	Bulk Carrier	0.227	0.195	0.772	-0.695	1.148
		Vehicles Carrier/RoRo	-0.345	0.0905	0.003***	-0.721	0.032
	Bulk Carrier	Vehicles Carrier/RoRo	-0.571	0.1727	0.038	-1.499	0.356
R1E2	General Cargo	Container Ship	-0.512	0.204	0.102	-1.359	0.335
		Bulk Carrier	-0.33	0.227	0.599	-1.323	0.664
		Vehicles Carrier/RoRo	-0.615	0.1576	0.005***	-1.335	0.104
	Container Ship	Bulk Carrier	0.182	0.2084	0.904	-0.736	1.101
		Vehicles Carrier/RoRo	-0.103	0.1294	0.930	-0.642	0.435
	Bulk Carrier	Vehicles Carrier/RoRo	-0.286	0.1634	0.440	-1.163	0.592
R1F1	General Cargo	Container Ship	-0.027	0.1626	1.000	-0.7	0.646
		Bulk Carrier	0.005	0.1767	1.000	-0.768	0.779
		Vehicles Carrier/RoRo	-1.423	0.5149	0.415	-339.227	336.381
	Container Ship	Bulk Carrier	0.032	0.1655	1.000	-0.691	0.755
		Vehicles Carrier/RoRo	-1.397	0.5112	0.425	-402.633	399.84
	Bulk Carrier	Vehicles Carrier/RoRo	-1.429	0.5158	0.413	-326.117	323.26
R1F3	General Cargo	Container Ship	-0.718	0.2308	0.026**	-1.696	0.261
		Bulk Carrier	0.231	0.3014	0.938	-1.103	1.565
		Vehicles Carrier/RoRo	-1.769	0.5373	0.314	-144.717	141.179
	Container Ship	Bulk Carrier	0.948	0.2585	0.011**	-0.272	2.168
		Vehicles Carrier/RoRo	-1.052	0.5144	0.542	-346.492	344.388
	Bulk Carrier	Vehicles Carrier/RoRo	-2.000	0.5497	0.260	-99.262	95.262

Remark **, *** Statistically significant at the .5 and .01 level respectively.

APPENDIX C

RESULT OF MANOVA FOR RESEARCH OBJECTIVE 2

Table C1 Descriptive statistics and parameter estimates (ship type)

Descriptive Statistics					Parameter Estimates					
Ship type		Average	SD	n	B	Std. Error	t	Sig.	95% Confidence Interval	
									Lower Bound	Upper Bound
R2A1	General Cargo	4.615	.4961	26	.356	.186	1.917	.058	-.012	.724
	Container Ship	4.190	.7122	58	-.070	.157	-.442	.659	-.381	.242
	Bulk Carrier	4.500	.5189	14	.241	.223	1.081	.282	-.200	.681
	Vehicles Carrier/RoRo	4.000	0.000	2	-.259	.495	-.523	.602	-1.240	.721
	≥2 types	4.259	.8130	27	0[a]					
	Total	4.323	.6887	127						
R2A3	General Cargo	1.962	.7200	26	-.631	.199	-3.179	.002***	-1.024	-.238
	Container Ship	2.328	.7105	58	-.265	.168	-1.574	.118	-.598	.068
	Bulk Carrier	2.429	.7559	14	-.164	.238	-.689	.492	-.635	.307
	Vehicles Carrier/RoRo	3.000	0.000	2	.407	.529	.769	.443	-.641	1.456
	≥2 types	2.593	.7473	27	0[a]					
	Total	2.331	.7459	127						
R2A4	General Cargo	2.269	.6668	26	-.323	.164	-1.968	.051	-.649	.002
	Container Ship	2.586	.5310	58	-.006	.139	-.046	.964	-.282	.269
	Bulk Carrier	2.429	.6462	14	-.164	.197	-.833	.407	-.554	.226
	Vehicles Carrier/RoRo	3.500	.7071	2	.907	.438	2.071	.041**	.040	1.775
	≥2 types	2.593	.6360	27	0[a]					
	Total	2.520	.6153	127						
R2A5	General Cargo	2.769	.9081	26	-.157	.247	-.635	.527	-.646	.332
	Container Ship	2.931	.8758	58	.005	.209	.024	.981	-.409	.420
	Bulk Carrier	2.786	.5789	14	-.140	.296	-.474	.637	-.726	.446
	Vehicles Carrier/RoRo	3.000	1.4142	2	.074	.659	.112	.911	-1.230	1.378
	≥2 types	2.926	1.035	27	0[a]					
	Total	2.882	.8874	127						
R2B1	General Cargo	2.500	.6481	26	-.352	.220	-1.599	.112	-.787	.084
	Container Ship	2.966	.8370	58	.114	.187	.609	.543	-.256	.483
	Bulk Carrier	2.786	.6993	14	-.066	.264	-.251	.802	-.588	.456
	Vehicles Carrier/RoRo	3.000	0.000	2	.148	.587	.253	.801	-1.013	1.310
	≥2 types	2.852	.9074	27	0[a]					
	Total	2.827	.8076	127						
R2B2	General Cargo	4.692	.6177	26	.507	.199	2.548	.012**	.113	.901
	Container Ship	4.190	.7599	58	.004	.169	.026	.979	-.330	.339
	Bulk Carrier	4.500	.7596	14	.315	.239	1.320	.189	-.157	.787
	Vehicles Carrier/RoRo	4.000	0.000	2	-.185	.531	-.349	.728	-1.236	.866
	≥2 types	4.185	.7357	27	0[a]					
	Total	4.323	.7441	127						
R2B3	General Cargo	2.577	.7575	26	-.312	.232	-1.346	.181	-.771	.147
	Container Ship	2.552	.8413	58	-.337	.196	-1.716	.089	-.726	.052
	Bulk Carrier	2.571	.6462	14	-.317	.278	-1.143	.255	-.867	.232
	Vehicles Carrier/RoRo	3.000	1.414	2	.111	.618	.180	.858	-1.112	1.335

Descriptive Statistics					Parameter Estimates					
	Ship type	Average	SD	n	B	Std. Error	t	Sig.	95% Confidence Interval	
									Lower Bound	Upper Bound
	≥2 types	2.889	.9740	27	0[a]					
	Total	2.638	.8420	127						
R2B5	General Cargo	2.846	.8339	26	-.228	.205	-1.110	.269	-.634	.179
	Container Ship	3.103	.6124	58	.029	.174	.169	.866	-.315	.374
	Bulk Carrier	2.500	.5189	14	-.574	.246	-2.333	.021	-1.061	-.087
	Vehicles Carrier/RoRo	4.000	0.000	2	.926	.548	1.691	.093	-.158	2.010
	≥2 types	3.074	.9971	27	0[a]					
	Total	2.992	.7715	127						
R2B7	General Cargo	3.385	1.022	26	.014	.274	.052	.959	-.528	.557
	Container Ship	3.069	1.006	58	-.301	.232	-1.297	.197	-.761	.159
	Bulk Carrier	3.357	.6333	14	-.013	.329	-.040	.968	-.664	.637
	Vehicles Carrier/RoRo	3.000	0.000	2	-.370	.731	-.507	.613	-1.817	1.077
	≥2 types	3.370	1.114	27	0[a]					
	Total	3.228	.9935	127						
R2C1	General Cargo	2.077	.7961	26	-.256	.231	-1.111	.269	-.713	.201
	Container Ship	2.328	.7105	58	-.006	.196	-.029	.977	-.393	.382
	Bulk Carrier	2.500	.8549	14	.167	.277	.602	.548	-.381	.714
	Vehicles Carrier/RoRo	3.000	0.000	2	.667	.616	1.083	.281	-.552	1.886
	≥2 types	2.333	1.109	27	0[a]					
	Total	2.307	.8406	127						
R2C2	General Cargo	1.731	.6038	26	-.380	.193	-1.972	.051	-.762	.001
	Container Ship	1.983	.6880	58	-.128	.164	-.785	.434	-.452	.195
	Bulk Carrier	1.714	.7263	14	-.397	.231	-1.716	.089	-.855	.061
	Vehicles Carrier/RoRo	2.500	.7071	2	.389	.514	.756	.451	-.630	1.407
	≥2 types	2.111	.8006	27	0[a]					
	Total	1.937	.7099	127						
R2C4	General Cargo	2.692	.5491	26	.211	.172	1.223	.224	-.130	.552
	Container Ship	2.448	.5974	58	-.033	.146	-.227	.821	-.322	.256
	Bulk Carrier	2.714	.6112	14	.233	.207	1.127	.262	-.176	.642
	Vehicles Carrier/RoRo	2.500	.7071	2	.019	.460	.040	.968	-.891	.928
	≥2 types	2.481	.7530	27	0[a]					
	Total	2.535	.6274	127						
R2C5	General Cargo	4.346	.7452	26	.309	.245	1.260	.210	-.176	.795
	Container Ship	3.759	.9967	58	-.278	.208	-1.339	.183	-.690	.133
	Bulk Carrier	4.143	1.027	14	.106	.294	.360	.719	-.476	.688
	Vehicles Carrier/RoRo	2.000	0.000	2	-2.037	.654	-3.114	.002***	-3.332	-.742
	≥2 types	4.037	.7061	27	0[a]					
	Total	3.953	.9416	127						
R2D1	General Cargo	4.038	.8709	26	-.036	.200	-.178	.859	-.432	.361
	Container Ship	4.069	.6974	58	-.005	.170	-.030	.976	-.341	.331
	Bulk Carrier	4.143	.6630	14	.069	.240	.287	.775	-.406	.544
	Vehicles Carrier/RoRo	3.500	.7071	2	-.574	.534	-1.075	.284	-1.631	.483
	≥2 types	4.074	.6752	27	0[a]					
	Total	4.063	.7210	127						
R2D2	General Cargo	3.538	.5818	26	-.387	.186	-2.086	.039**	-.755	-.020
	Container Ship	4.034	.7000	58	.109	.157	.689	.492	-.203	.420
	Bulk Carrier	3.500	.7596	14	-.426	.223	-1.913	.058	-.867	.015

Descriptive Statistics					Parameter Estimates					
	Ship type	Average	SD	n	B	Std. Error	t	Sig.	95% Confidence Interval	
									Lower Bound	Upper Bound
	Vehicles Carrier/RoRo	4.000	0.000	2	.074	.495	.150	.881	-.907	1.055
	≥2 types	3.926	.6752	27	0[a]					
	Total	3.850	.7024	127						
R2D3	General Cargo	3.423	.5778	26	-.170	.161	-1.050	.296	-.489	.150
	Container Ship	3.862	.6055	58	.269	.137	1.969	.051	-.002	.540
	Bulk Carrier	3.214	.4258	14	-.378	.194	-1.955	.053	-.761	.005
	Vehicles Carrier/RoRo	4.000	0.000	2	.407	.431	.946	.346	-.445	1.260
	≥2 types	3.593	.6360	27	0[a]					
	Total	3.646	.6240	127						
R2D4	General Cargo	3.769	.9081	26	-.268	.199	-1.344	.181	-.662	.127
	Container Ship	4.241	.6300	58	.204	.169	1.210	.229	-.130	.539
	Bulk Carrier	3.571	.7559	14	-.466	.239	-1.950	.053	-.938	.007
	Vehicles Carrier/RoRo	3.500	.7071	2	-.537	.531	-1.011	.314	-1.589	.515
	≥2 types	4.037	.7061	27	0[a]					
	Total	4.016	.7558	127						
R2E1	General Cargo	2.346	.6895	26	-.172	.260	-.663	.509	-.687	.343
	Container Ship	2.638	.9858	58	.119	.221	.541	.589	-.317	.556
	Bulk Carrier	2.286	.8254	14	-.233	.312	-.747	.457	-.850	.385
	Vehicles Carrier/RoRo	2.500	.7071	2	-.019	.694	-.027	.979	-1.392	1.355
	≥2 types	2.519	1.122	27	0[a]					
	Total	2.512	.9417	127						
R2E2	General Cargo	4.500	.5831	26	.167	.190	.877	.382	-.210	.543
	Container Ship	4.034	.7485	58	-.299	.161	-1.855	.066	-.618	.020
	Bulk Carrier	4.571	.6462	14	.238	.228	1.045	.298	-.213	.689
	Vehicles Carrier/RoRo	3.500	.7071	2	-.833	.507	-1.644	.103	-1.837	.170
	≥2 types	4.333	.6794	27	0[a]					
	Total	4.244	.7206	127						
R2E3	General Cargo	4.385	.8521	26	.014	.184	.078	.938	-.349	.378
	Container Ship	4.379	.5241	58	.009	.156	.057	.954	-.299	.317
	Bulk Carrier	4.214	.9750	14	-.156	.220	-.709	.479	-.592	.280
	Vehicles Carrier/RoRo	4.000	0.000	2	-.370	.490	-.756	.451	-1.340	.599
	≥2 types	4.370	.5649	27	0[a]					
	Total	4.354	.6610	127						
R2E4	General Cargo	2.577	.6433	26	.132	.187	.710	.479	-.237	.502
	Container Ship	2.414	.7017	58	-.031	.158	-.194	.847	-.344	.283
	Bulk Carrier	2.357	.8419	14	-.087	.224	-.390	.697	-.530	.356
	Vehicles Carrier/RoRo	2.000	0.000	2	-.444	.498	-.893	.374	-1.430	.541
	≥2 types	2.444	.5774	27	0[a]					
	Total	2.441	.6744	127						
R2E5	General Cargo	2.962	.9157	26	-.557	.301	-1.849	.067	-1.153	.039
	Container Ship	3.207	1.135	58	-.312	.255	-1.220	.225	-.817	.194
	Bulk Carrier	2.929	1.141	14	-.590	.361	-1.634	.105	-1.305	.125
	Vehicles Carrier/RoRo	3.500	.7071	2	-.019	.803	-.023	.982	-1.609	1.572
	≥2 types	3.519	1.155	27	0[a]					
	Total	3.197	1.098	127						
R2E6	General Cargo	3.846	.8339	26	.068	.228	.300	.764	-.382	.519
	Container Ship	3.862	.8675	58	.084	.193	.437	.663	-.298	.467

Descriptive Statistics					Parameter Estimates					
	Ship type	Average	SD	n	B	Std. Error	t	Sig.	95% Confidence Interval	
									Lower Bound	Upper Bound
	Bulk Carrier	3.714	.8254	14	-.063	.273	-.233	.816	-.604	.477
	Vehicles Carrier/RoRo	4.000	0.000	2	.222	.607	.366	.715	-.980	1.425
	≥2 types	3.778	.7511	27	0[a]					
	Total	3.827	.8174	127						
R2E7	General Cargo	3.615	.9414	26	-.385	.223	-1.725	.087	-.826	.057
	Container Ship	4.121	.7511	58	.121	.189	.638	.524	-.254	.495
	Bulk Carrier	3.500	.9405	14	-.500	.267	-1.871	.064	-1.029	.029
	Vehicles Carrier/RoRo	4.500	.7071	2	.500	.595	.841	.402	-.677	1.677
	≥2 types	4.000	.7338	27	0[a]					
	Total	3.929	.8374	127						

Remark [a] The base group.
, * Statistically significant at .05 level and .01 level.

Table C2 Post hoc test (ship type) the 3rd round of MANOVA for objective 2

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
R2A1	General Cargo	Container Ship	.426*	.1350	.020**	.047	.804
		Bulk Carrier	.115	.1694	.959	-.381	.612
		Vehicles Carrier/RoRo	.615*	.0973	.000***	.330	.901
	Container Ship	Bulk Carrier	-.310	.1673	.365	-.800	.179
		Vehicles Carrier/RoRo	.190	.0935	.266	-.074	.453
	Bulk Carrier	Vehicles Carrier/RoRo	.500*	.1387	.022**	.063	.937
R2A3	General Cargo	Container Ship	-.366	.1692	.212	-.846	.114
		Bulk Carrier	-.467	.2465	.345	-1.190	.256
		Vehicles Carrier/RoRo	-1.038*	.1412	.000***	-1.453	-.624
	Container Ship	Bulk Carrier	-.101	.2225	.991	-.770	.568
		Vehicles Carrier/RoRo	-.672*	.0933	.000***	-.935	-.410
	Bulk Carrier	Vehicles Carrier/RoRo	-.571	.2020	.087	-1.208	.065
R2A4	General Cargo	Container Ship	-.317	.1482	.224	-.740	.106
		Bulk Carrier	-.159	.2166	.946	-.791	.473
		Vehicles Carrier/RoRo	-1.231	.5168	.473	-11.118	8.656
	Container Ship	Bulk Carrier	.158	.1862	.912	-.407	.723
		Vehicles Carrier/RoRo	-.914	.5048	.606	-12.929	11.102
	Bulk Carrier	Vehicles Carrier/RoRo	-1.071	.5290	.531	-9.413	7.270
R2A5	General Cargo	Container Ship	-.162	.2120	.940	-.763	.440
		Bulk Carrier	-.016	.2359	1.000	-.693	.660
		Vehicles Carrier/RoRo	-.231	1.0157	.998	-23.043	22.582
	Container Ship	Bulk Carrier	.145	.1928	.942	-.415	.705
		Vehicles Carrier/RoRo	-.069	1.0066	1.000	-24.763	24.625
	Bulk Carrier	Vehicles Carrier/RoRo	-.214	1.0119	.999	-23.787	23.358
R2B1	General Cargo	Container Ship	-.466	.1680	.055	-.938	.007
		Bulk Carrier	-.286	.2260	.715	-.949	.378
		Vehicles Carrier/RoRo	-.500*	.1271	.005***	-.873	-.127
	Container Ship	Bulk Carrier	.180	.2168	.919	-.461	.821
		Vehicles Carrier/RoRo	-.034	.1099	.998	-.344	.275
	Bulk Carrier	Vehicles Carrier/RoRo	-.214	.1869	.780	-.803	.374
R2B2	General Cargo	Container Ship	.503*	.1569	.018**	.061	.944
		Bulk Carrier	.192	.2364	.924	-.508	.893
		Vehicles Carrier/RoRo	.692*	.1211	.000***	.337	1.048
	Container Ship	Bulk Carrier	-.310	.2262	.652	-.988	.367
		Vehicles Carrier/RoRo	.190	.0998	.329	-.091	.471
	Bulk Carrier	Vehicles Carrier/RoRo	.500	.2030	.159	-.139	1.139
R2B3	General Cargo	Container Ship	.025	.1851	1.000	-.498	.548
		Bulk Carrier	.005	.2278	1.000	-.654	.665
		Vehicles Carrier/RoRo	-.423	1.0110	.986	-24.183	23.337
	Container Ship	Bulk Carrier	-.020	.2050	1.000	-.622	.583

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
		Vehicles Carrier/RoRo	-.448	1.0061	.982	-25.255	24.358
	Bulk Carrier	Vehicles Carrier/RoRo	-.429	1.0148	.985	-23.423	22.566
R2B5	General Cargo	Container Ship	-.257	.1822	.624	-.779	.265
		Bulk Carrier	.346	.2144	.498	-.269	.961
		Vehicles Carrier/RoRo	-1.154*	.1635	.000***	-1.634	-.674
	Container Ship	Bulk Carrier	.603*	.1603	.008***	.129	1.078
		Vehicles Carrier/RoRo	-.897*	.0804	.000***	-1.123	-.670
	Bulk Carrier	Vehicles Carrier/RoRo	-1.500*	.1387	.000***	-1.937	-1.063
R2B7	General Cargo	Container Ship	.316	.2402	.684	-.365	.997
		Bulk Carrier	.027	.2625	1.000	-.725	.780
		Vehicles Carrier/RoRo	.385	.2006	.335	-.204	.974
	Container Ship	Bulk Carrier	-.288	.2147	.668	-.910	.333
		Vehicles Carrier/RoRo	.069	.1321	.985	-.303	.441
	Bulk Carrier	Vehicles Carrier/RoRo	.357	.1693	.273	-.176	.890
R2C1	General Cargo	Container Ship	-.251	.1819	.645	-.768	.267
		Bulk Carrier	-.423	.2767	.554	-1.235	.389
		Vehicles Carrier/RoRo	-.923*	.1561	.000***	-1.382	-.465
	Container Ship	Bulk Carrier	-.172	.2468	.954	-.920	.576
		Vehicles Carrier/RoRo	-.672*	.0933	.000***	-.935	-.410
	Bulk Carrier	Vehicles Carrier/RoRo	-.500	.2285	.243	-1.219	.219
R2C2	General Cargo	Container Ship	-.252	.1489	.447	-.672	.168
		Bulk Carrier	.016	.2274	1.000	-.656	.689
		Vehicles Carrier/RoRo	-.769	.5138	.683	-11.121	9.583
	Container Ship	Bulk Carrier	.268	.2141	.721	-.375	.912
		Vehicles Carrier/RoRo	-.517	.5081	.837	-11.879	10.844
	Bulk Carrier	Vehicles Carrier/RoRo	-.786	.5364	.681	-8.399	6.827
R2C4	General Cargo	Container Ship	.244	.1332	.367	-.132	.620
		Bulk Carrier	-.022	.1957	1.000	-.598	.554
		Vehicles Carrier/RoRo	.192	.5115	.990	-10.557	10.941
	Container Ship	Bulk Carrier	-.266	.1812	.594	-.810	.278
		Vehicles Carrier/RoRo	-.052	.5061	1.000	-11.803	11.700
	Bulk Carrier	Vehicles Carrier/RoRo	.214	.5260	.988	-8.462	8.891
R2C5	General Cargo	Container Ship	.588*	.1962	.031	.037	1.138
		Bulk Carrier	.203	.3110	.964	-.725	1.132
		Vehicles Carrier/RoRo	2.346*	.1462	.000***	1.917	2.775
	Container Ship	Bulk Carrier	-.384	.3041	.716	-1.297	.529
		Vehicles Carrier/RoRo	1.759*	.1309	.000***	1.390	2.127
	Bulk Carrier	Vehicles Carrier/RoRo	2.143*	.2745	.000***	1.279	3.007
R2D1	General Cargo	Container Ship	-.031	.1938	1.000	-.584	.523
		Bulk Carrier	-.104	.2461	.993	-.814	.605
		Vehicles Carrier/RoRo	.538	.5284	.835	-7.862	8.939
	Container Ship	Bulk Carrier	-.074	.1995	.996	-.669	.521
		Vehicles Carrier/RoRo	.569	.5083	.804	-10.751	11.889
	Bulk Carrier	Vehicles Carrier/RoRo	.643	.5305	.768	-7.541	8.827
R2D2	General Cargo	Container Ship	-.496*	.1465	.011**	-.909	-.083
		Bulk Carrier	.038	.2329	1.000	-.654	.731
		Vehicles Carrier/RoRo	-.462*	.1141	.004***	-.797	-.126
	Container Ship	Bulk Carrier	.534	.2228	.159	-.137	1.206
		Vehicles Carrier/RoRo	.034	.0919	.996	-.224	.293
	Bulk Carrier	Vehicles Carrier/RoRo	-.500	.2030	.159	-1.139	.139
R2D3	General Cargo	Container Ship	-.439*	.1384	.021	-.831	-.047
		Bulk Carrier	.209	.1606	.693	-.254	.671
		Vehicles Carrier/RoRo	-.577*	.1133	.000***	-.910	-.244
	Container Ship	Bulk Carrier	.648*	.1388	.001***	.243	1.053
		Vehicles Carrier/RoRo	-.138	.0795	.421	-.362	.086
	Bulk Carrier	Vehicles Carrier/RoRo	-.786*	.1138	.000***	-1.144	-.427
R2D4	General Cargo	Container Ship	-.472	.1964	.137	-1.036	.091
		Bulk Carrier	.198	.2693	.947	-.581	.977
		Vehicles Carrier/RoRo	.269	.5308	.975	-7.874	8.413
	Container Ship	Bulk Carrier	.670*	.2183	.046	.008	1.332
		Vehicles Carrier/RoRo	.741	.5068	.697	-10.874	12.356
	Bulk Carrier	Vehicles Carrier/RoRo	.071	.5393	1.000	-7.287	7.430
R2E1	General Cargo	Container Ship	-.292	.1872	.529	-.817	.233

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
		Bulk Carrier	.060	.2587	.999	-.705	.826
		Vehicles Carrier/RoRo	-.154	.5180	.996	-9.872	9.565
	Container Ship	Bulk Carrier	.352	.2558	.648	-.404	1.109
		Vehicles Carrier/RoRo	.138	.5165	.997	-9.797	10.073
	Bulk Carrier	Vehicles Carrier/RoRo	-.214	.5465	.990	-7.013	6.584
R2E2	General Cargo	Container Ship	.466*	.1508	.024**	.042	.889
		Bulk Carrier	-.071	.2071	.997	-.681	.538
		Vehicles Carrier/RoRo	1.000	.5129	.565	-9.503	11.503
	Container Ship	Bulk Carrier	-.537	.1987	.086	-1.126	.052
		Vehicles Carrier/RoRo	.534	.5096	.826	-10.552	11.621
	Bulk Carrier	Vehicles Carrier/RoRo	1.071	.5290	.531	-7.270	9.413
R2E3	General Cargo	Container Ship	.005	.1807	1.000	-.515	.526
		Bulk Carrier	.170	.3096	.981	-.742	1.083
		Vehicles Carrier/RoRo	.385	.1671	.178	-.106	.875
	Container Ship	Bulk Carrier	.165	.2695	.971	-.668	.998
		Vehicles Carrier/RoRo	.379*	.0688	.000***	.185	.573
	Bulk Carrier	Vehicles Carrier/RoRo	.214	.2606	.919	-.606	1.035
R2E4	General Cargo	Container Ship	.163	.1562	.834	-.278	.605
		Bulk Carrier	.220	.2580	.911	-.548	.987
		Vehicles Carrier/RoRo	.577*	.1262	.001***	.206	.947
	Container Ship	Bulk Carrier	.057	.2431	.999	-.680	.794
		Vehicles Carrier/RoRo	.414*	.0921	.000***	.154	.673
	Bulk Carrier	Vehicles Carrier/RoRo	.357	.2250	.530	-.351	1.066
R2E5	General Cargo	Container Ship	-.245	.2334	.830	-.902	.411
		Bulk Carrier	.033	.3539	1.000	-1.016	1.082
		Vehicles Carrier/RoRo	-.538	.5313	.837	-8.630	7.553
	Container Ship	Bulk Carrier	.278	.3395	.921	-.739	1.296
		Vehicles Carrier/RoRo	-.293	.5218	.965	-9.485	8.898
	Bulk Carrier	Vehicles Carrier/RoRo	-.571	.5857	.850	-5.479	4.336
R2E6	General Cargo	Container Ship	-.016	.1993	1.000	-.580	.548
		Bulk Carrier	.132	.2746	.989	-.670	.934
		Vehicles Carrier/RoRo	-.154	.1635	.878	-.634	.326
	Container Ship	Bulk Carrier	.148	.2483	.974	-.593	.889
		Vehicles Carrier/RoRo	-.138	.1139	.745	-.459	.183
	Bulk Carrier	Vehicles Carrier/RoRo	-.286	.2206	.699	-.980	.409
R2E7	General Cargo	Container Ship	-.505	.2093	.133	-1.103	.093
		Bulk Carrier	.115	.3119	.996	-.796	1.027
		Vehicles Carrier/RoRo	-.885	.5330	.623	-8.803	7.034
	Container Ship	Bulk Carrier	.621	.2700	.192	-.200	1.441
		Vehicles Carrier/RoRo	-.379	.5096	.921	-11.454	10.695
	Bulk Carrier	Vehicles Carrier/RoRo	-1.000	.5596	.567	-6.988	4.988

APPENDIX D

RESULT OF MANOVA FOR RESEARCH OBJECTIVE 4

Table D1 Descriptive statistics and parameter estimates

Descriptive Statistics					Parameter Estimates					
	Ship type	Average	SD	n	B	Std. Error	t	Sig.	95% Confidence Interval	
									Lower Bound	Upper Bound
R3A3	General Cargo	4.115	.9089	26	.338	.270	1.252	.213	-.196	.871
	Container Ship	3.517	1.0129	58	-.261	.229	-1.139	.257	-.713	.192
	Bulk Carrier	4.143	1.0271	14	.365	.323	1.129	.261	-.275	1.005
	Vehicles Carrier/RoRo	3.000	0.0000	2	-.778	.719	-1.081	.282	-2.202	.646
	≥2 types	3.778	.9740	27	0[a]					
	Total	3.756	1.0057	127						
R3A4	General Cargo	3.808	.9806	26	.215	.252	.853	.395	-.284	.714
	Container Ship	3.397	.9165	58	-.196	.214	-.917	.361	-.619	.227
	Bulk Carrier	3.786	.8018	14	.193	.302	.639	.524	-.405	.792
	Vehicles Carrier/RoRo	3.000	1.4142	2	-.593	.673	-.881	.380	-1.924	.739
	≥2 types	3.593	.8884	27	0[a]					
	Total	3.559	.9228	127						
R3A7	General Cargo	4.538	.5818	26	.168	.165	1.019	.310	-.159	.495
	Container Ship	4.138	.6338	58	-.232	.140	-1.661	.099	-.509	.045
	Bulk Carrier	4.214	.6993	14	-.156	.198	-.789	.432	-.548	.236
	Vehicles Carrier/RoRo	4.000	0.0000	2	-.370	.440	-.841	.402	-1.242	.501
	≥2 types	4.370	.4921	27	0[a]					
	Total	4.276	.6130	127						
R3B2	General Cargo	3.808	.8010	26	.474	.197	2.406	.018**	.084	.865
	Container Ship	3.034	.6745	58	-.299	.167	-1.788	.076	-.630	.032
	Bulk Carrier	3.714	.8254	14	.381	.236	1.612	.110	-.087	.849
	Vehicles Carrier/RoRo	4.000	0.0000	2	.667	.526	1.268	.207	-.374	1.708
	≥2 types	3.333	.6794	27	0[a]					
	Total	3.346	.7805	127						
R3B3	General Cargo	2.577	.7027	26	-.349	.237	-1.470	.144	-.819	.121
	Container Ship	3.052	.9257	58	.126	.201	.625	.533	-.273	.524
	Bulk Carrier	3.000	.7845	14	.074	.285	.260	.795	-.489	.637
	Vehicles Carrier/RoRo	4.000	0.0000	2	1.074	.633	1.697	.092	-.179	2.327
	≥2 types	2.926	.9168	27	0[a]					
	Total	2.937	.8796	127						
R3B5	General Cargo	4.231	.7646	26	-.177	.184	-.958	.340	-.542	.188
	Container Ship	4.534	.5686	58	.127	.156	.813	.418	-.182	.437
	Bulk Carrier	4.286	.8254	14	-.122	.221	-.551	.583	-.559	.316
	Vehicles Carrier/RoRo	4.500	.7071	2	.093	.492	.188	.851	-.881	1.066
	≥2 types	4.407	.6939	27	0[a]					
	Total	4.417	.6719	127						
R3B8	General Cargo	4.423	.6433	26	.312	.211	1.477	.142	-.106	.730
	Container Ship	4.259	.8698	58	.148	.179	.823	.412	-.207	.502
	Bulk Carrier	4.500	.5189	14	.389	.253	1.536	.127	-.112	.890
	Vehicles Carrier/RoRo	4.500	.7071	2	.389	.563	.690	.491	-.727	1.504
	≥2 types	4.111	.7511	27	0[a]					
	Total	4.291	.7675	127						
R3C4	General Cargo	2.385	.8979	26	-.801	.252	-3.181	.002***	-1.299	-.302
	Container Ship	3.534	.9218	58	.349	.213	1.637	.104	-.073	.772
	Bulk Carrier	2.357	.7449	14	-.828	.302	-2.745	.007***	-1.425	-.231
	Vehicles Carrier/RoRo	4.500	.7071	2	1.315	.671	1.959	.052	-.014	2.644
	≥2 types	3.185	1.0014	27	0[a]					
	Total	3.110	1.0483	127						
R3C6	General Cargo	3.154	.9672	26	.117	.266	.440	.661	-.409	.643
	Container Ship	2.948	.8870	58	-.089	.225	-.394	.694	-.535	.357
	Bulk Carrier	3.214	1.1217	14	.177	.318	.557	.579	-.453	.808
	Vehicles Carrier/RoRo	3.500	.7071	2	.463	.709	.653	.515	-.940	1.866
	≥2 types	3.037	1.0554	27	0[a]					
	Total	3.047	.9583	127						
R3C8	General Cargo	4.115	.9089	26	.523	.258	2.023	.045**	.011	1.034
	Container Ship	3.466	.9772	58	-.127	.219	-.580	.563	-.561	.307
	Bulk Carrier	4.214	.8018	14	.622	.310	2.007	.047**	.008	1.235
	Vehicles Carrier/RoRo	4.000	0.0000	2	.407	.689	.591	.556	-.957	1.772
	≥2 types	3.593	.9711	27	0[a]					
	Total	3.717	.9751	127						
R3D3	General Cargo	2.692	1.1923	26	-.530	.287	-1.848	.067	-1.097	.038
	Container Ship	3.655	1.0009	58	.433	.243	1.781	.077	-.048	.914

Descriptive Statistics					Parameter Estimates					
	Ship type	Average	SD	n	B	Std. Error	t	Sig.	95% Confidence Interval	
									Lower Bound	Upper Bound
	Bulk Carrier	2.500	.8549	14	-.722	.344	-2.102	.038**	-1.402	-.042
	Vehicles Carrier/RoRo	4.000	0.0000	2	.778	.765	1.017	.311	-.736	2.291
	≥2 types	3.222	1.0860	27	0[a]					
	Total	3.244	1.1249	127						
R3D5	General Cargo	3.731	.8274	26	-.084	.247	-.340	.735	-.574	.406
	Container Ship	3.621	.9702	58	-.194	.210	-.926	.356	-.609	.221
	Bulk Carrier	4.000	.8771	14	.185	.296	.625	.533	-.402	.772
	Vehicles Carrier/RoRo	4.000	0.0000	2	.185	.660	.281	.779	-1.121	1.491
	≥2 types	3.815	.8338	27	0[a]					
	Total	3.732	.8949	127						
R3D7	General Cargo	3.577	1.5792	26	-.164	.335	-.490	.625	-.826	.499
	Container Ship	3.914	.9784	58	.173	.284	.610	.543	-.389	.735
	Bulk Carrier	3.714	1.5407	14	-.026	.401	-.066	.948	-.820	.768
	Vehicles Carrier/RoRo	4.000	0.0000	2	.259	.893	.290	.772	-1.508	2.026
	≥2 types	3.741	1.1298	27	0[a]					
	Total	3.787	1.2060	127						
R3D8	General Cargo	4.577	.5038	26	.170	.236	.719	.474	-.297	.637
	Container Ship	4.052	1.0332	58	-.356	.200	-1.778	.078	-.752	.040
	Bulk Carrier	4.857	.3631	14	.450	.283	1.591	.114	-.110	1.009
	Vehicles Carrier/RoRo	4.500	.7071	2	.093	.629	.147	.883	-1.153	1.338
	≥2 types	4.407	.8884	27	0[a]					
	Total	4.331	.8914	127						

Remark **, *** Statistically significant at .05 level and .01 level respectively.

Table D2 Post hoc test

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
R3A3	General Cargo	Container Ship	.598	.2316	.110	-.064	1.260
		Bulk Carrier	-.027	.3253	1.000	-.958	.903
		Vehicles Carrier/RoRo	1.115	.7202	1.000	-.944	3.174
	Container Ship	Bulk Carrier	-.626	.2923	.343	-1.461	.210
		Vehicles Carrier/RoRo	.517	.7059	1.000	-1.501	2.535
	Bulk Carrier	Vehicles Carrier/RoRo	1.143	.7419	1.000	-.978	3.264
R3A4	General Cargo	Container Ship	.411	.2166	.601	-.208	1.031
		Bulk Carrier	.022	.3043	1.000	-.848	.892
		Vehicles Carrier/RoRo	.808	.6736	1.000	-1.118	2.733
	Container Ship	Bulk Carrier	-.389	.2733	1.000	-1.171	.392
		Vehicles Carrier/RoRo	.397	.6602	1.000	-1.491	2.284
	Bulk Carrier	Vehicles Carrier/RoRo	.786	.6939	1.000	-1.198	2.770
R3A7	General Cargo	Container Ship	.401	.1418	.055	-.005	.806
		Bulk Carrier	.324	.1991	1.000	-.245	.893
		Vehicles Carrier/RoRo	.538	.4407	1.000	-.722	1.799
	Container Ship	Bulk Carrier	-.076	.1789	1.000	-.588	.435
		Vehicles Carrier/RoRo	.138	.4320	1.000	-1.097	1.373
	Bulk Carrier	Vehicles Carrier/RoRo	.214	.4540	1.000	-1.084	1.512
R3B2	General Cargo	Container Ship	.773*	.1694	.000***	.289	1.257
		Bulk Carrier	.093	.2379	1.000	-.587	.774
		Vehicles Carrier/RoRo	-.192	.5266	1.000	-1.698	1.313
	Container Ship	Bulk Carrier	-.680*	.2137	.019**	-1.291	-.069
		Vehicles Carrier/RoRo	-.966	.5161	.638	-2.441	.510
	Bulk Carrier	Vehicles Carrier/RoRo	-.286	.5425	1.000	-1.837	1.265
R3B3	General Cargo	Container Ship	-.475	.2039	.215	-1.058	.108
		Bulk Carrier	-.423	.2864	1.000	-1.242	.396
		Vehicles Carrier/RoRo	-1.423	.6339	.266	-3.235	.389
	Container Ship	Bulk Carrier	.052	.2572	1.000	-.684	.787
		Vehicles Carrier/RoRo	-.948	.6213	1.000	-2.725	.828
	Bulk Carrier	Vehicles Carrier/RoRo	-1.000	.6530	1.000	-2.867	.867
R3B5	General Cargo	Container Ship	-.304	.1584	.575	-.756	.149
		Bulk Carrier	-.055	.2224	1.000	-.691	.581
		Vehicles Carrier/RoRo	-.269	.4923	1.000	-1.677	1.138
	Container Ship	Bulk Carrier	.249	.1998	1.000	-.322	.820
		Vehicles Carrier/RoRo	.034	.4825	1.000	-1.345	1.414
	Bulk Carrier	Vehicles Carrier/RoRo	-.214	.5072	1.000	-1.664	1.236

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
R3B8	General Cargo	Container Ship	.164	.1815	1.000	-.354	.683
		Bulk Carrier	-.077	.2549	1.000	-.806	.652
		Vehicles Carrier/RoRo	-.077	.5642	1.000	-1.690	1.536
	Container Ship	Bulk Carrier	-.241	.2290	1.000	-.896	.413
		Vehicles Carrier/RoRo	-.241	.5530	1.000	-1.822	1.340
	Bulk Carrier	Vehicles Carrier/RoRo	0.000	.5813	1.000	-1.662	1.662
R3C4	General Cargo	Container Ship	-1.150*	.2162	.000***	-1.768	-.532
		Bulk Carrier	.027	.3037	1.000	-.841	.896
		Vehicles Carrier/RoRo	-2.115*	.6722	.021**	-4.037	-.194
	Container Ship	Bulk Carrier	1.177*	.2728	.000***	.397	1.957
		Vehicles Carrier/RoRo	-.966	.6588	1.000	-2.849	.918
	Bulk Carrier	Vehicles Carrier/RoRo	-2.143*	.6925	.024**	-4.123	-.163
R3C6	General Cargo	Container Ship	.206	.2282	1.000	-.447	.858
		Bulk Carrier	-.060	.3205	1.000	-.977	.856
		Vehicles Carrier/RoRo	-.346	.7095	1.000	-2.375	1.682
	Container Ship	Bulk Carrier	-.266	.2879	1.000	-1.089	.557
		Vehicles Carrier/RoRo	-.552	.6954	1.000	-2.540	1.436
	Bulk Carrier	Vehicles Carrier/RoRo	-.286	.7309	1.000	-2.375	1.804
R3C8	General Cargo	Container Ship	.650*	.2220	.041**	.015	1.285
		Bulk Carrier	-.099	.3118	1.000	-.990	.793
		Vehicles Carrier/RoRo	.115	.6903	1.000	-1.858	2.089
	Container Ship	Bulk Carrier	-.749	.2801	.085	-1.550	.052
		Vehicles Carrier/RoRo	-.534	.6765	1.000	-2.469	1.400
	Bulk Carrier	Vehicles Carrier/RoRo	.214	.7111	1.000	-1.819	2.247
R3D3	General Cargo	Container Ship	-.963*	.2462	.002***	-1.667	-.259
		Bulk Carrier	.192	.3459	1.000	-.797	1.181
		Vehicles Carrier/RoRo	-1.308	.7656	.902	-3.497	.881
	Container Ship	Bulk Carrier	1.155*	.3107	.003***	.267	2.043
		Vehicles Carrier/RoRo	-.345	.7504	1.000	-2.490	1.800
	Bulk Carrier	Vehicles Carrier/RoRo	-1.500	.7887	.595	-3.755	.755
R3D5	General Cargo	Container Ship	.110	.2124	1.000	-.497	.717
		Bulk Carrier	-.269	.2984	1.000	-1.122	.584
		Vehicles Carrier/RoRo	-.269	.6605	1.000	-2.158	1.619
	Container Ship	Bulk Carrier	-.379	.2680	1.000	-1.146	.387
		Vehicles Carrier/RoRo	-.379	.6474	1.000	-2.230	1.471
	Bulk Carrier	Vehicles Carrier/RoRo	.000	.6804	1.000	-1.945	1.945
R3D7	General Cargo	Container Ship	-.337	.2874	1.000	-1.159	.485
		Bulk Carrier	-.137	.4037	1.000	-1.292	1.017
		Vehicles Carrier/RoRo	-.423	.8937	1.000	-2.978	2.132
	Container Ship	Bulk Carrier	.200	.3627	1.000	-.837	1.236
		Vehicles Carrier/RoRo	-.086	.8759	1.000	-2.590	2.418
	Bulk Carrier	Vehicles Carrier/RoRo	-.286	.9206	1.000	-2.918	2.346
R3D8	General Cargo	Container Ship	.525	.2026	.107	-.054	1.105
		Bulk Carrier	-.280	.2846	1.000	-1.094	.533
		Vehicles Carrier/RoRo	.077	.6300	1.000	-1.724	1.878
	Container Ship	Bulk Carrier	-.805*	.2556	.021	-1.536	-.075
		Vehicles Carrier/RoRo	-.448	.6175	1.000	-2.214	1.317
	Bulk Carrier	Vehicles Carrier/RoRo	.357	.6490	1.000	-1.498	2.213

Remark **, *** Statistically significant at .05 level and .01 level respectively.

APPENDIX E

QUESTIONNAIRE

Questionnaire part 1

ส่วนที่ 1 ข้อมูลทั่วไปเกี่ยวกับการใช้บริการเก็บขยะจากเรือที่ท่าเรือแหลมฉบัง

1 โปรดระบุชื่อบริษัทของท่าน.....

2 ท่านติดต่อท่าเรือแหลมฉบังเพื่อขอใช้บริการเก็บขยะจากเรือขยะด้วยวิธีใดบ้าง

☐ ยื่นเอกสารคำร้องขอใช้บริการเก็บขยะด้วยพนักงาน ☐ เอกสารอิเล็กทรอนิคผ่านระบบอินเตอร์เน็ต

☐ แจ้งคำขอใช้บริการเก็บขยะ โดยโทรศัพท์ อื่นๆ โปรดระบุ.....

3 ท่านทราบข้อมูลบริการเก็บขยะของท่าเรือแหลมฉบังจากช่องทางใด

☐ ตัวแทนสายเรือ ☐ ผู้ประกอบการท่าเทียบเรือ ☐ คู่มือการใช้บริการท่าเรือแหลมฉบัง

☐ เจ้าหน้าที่ของท่าเรือ ☐ เว็บไซต์ของท่าเรือแหลมฉบัง อื่นๆ โปรดระบุ.....

4 ท่านใช้บริการเก็บขยะจากเรือของท่าเรือแหลมฉบังบ่อยเพียงใด

☐ ใช้ทุกครั้งที่เรือเข้าเทียบท่า ☐ 70%-79% ของเรือที่เข้าเทียบท่า ☐ 10%-29% ของเรือที่เข้าเทียบท่า

☐ 90%-99% ของเรือที่เข้าเทียบท่า ☐ 50%-69% ของเรือที่เข้าเทียบท่า ☐ 1%-9% ของเรือที่เข้าเทียบท่า

☐ 80%-89% ของเรือที่เข้าเทียบท่า ☐ 30%-49% ของเรือที่เข้าเทียบท่า ☐ ไม่เคยใช้กรณีเรือเข้าท่า

5 บุคคลใดเป็นผู้ตัดสินใจว่าจะทิ้งขยะที่ท่าเรือแหลมฉบังหรือไม่

☐ กัปตันเรือ ☐ ผู้จัดการสายเรือ ☐ ตัวแทนเรือ ☐ ผู้บริหารของบริษัท อื่นๆ โปรดระบุ.....

6 ท่านทิ้งขยะที่ท่าเรือแหลมฉบังโดยเฉลี่ยปีละกี่กิโลกรัม

ขยะทั่วไป.....กิโลกรัม/ ขยะอันตราย.....กิโลกรัม/ปี

7 โปรดเรียงลำดับความสำคัญ 1-8 ของปัจจัยที่ส่งผลต่อบริการเก็บขยะของท่าเรือแหลมฉบัง ลงในวงเล็บ ( )

( ) ความเพียงพอของอุปกรณ์รองรับขยะจากเรือ ( ) สถานที่ตั้งของจุดรับบริการ ( ) ความสะดวกสบายในการติดต่อเพื่อขอใช้บริการ

( ) ประสิทธิภาพของกระบวนการเก็บขยะจากเรือ ( ) ค่าใช้จ่ายของการให้บริการเก็บขยะจากเรือ ( ) อื่นๆ.....

( ) ความง่ายของขั้นตอนในการขอใช้บริการเก็บขยะจากเรือ ( ) ความง่ายในการเข้าถึงข้อมูลบริการเก็บขยะจากเรือ

8 โปรดเรียงลำดับความสำคัญ 1-6 ของเหตุผลที่ทำให้ท่านใช้บริการเก็บขยะจากเรือของท่าเรือแหลมฉบัง ลงในวงเล็บ ( )

( ) กฎหมาย/ระเบียบบังคับให้ใช้บริการ ( ) พื้นที่สำหรับเก็บขยะบนเรือมีกำจัด ( ) บริษัทกำหนดให้เรือต้องใช้บริการ

( ) ไม่ทำให้เรือเกิดความล่าช้า ( ) ค่าใช้จ่ายที่สมเหตุสมผล ( ) อื่นๆ.....

9 โปรดเรียงลำดับความสำคัญ 1-6 ของเหตุผลที่ทำให้ท่านไม่ใช้บริการเก็บขยะจากเรือของท่าเรือแหลมฉบัง ลงในวงเล็บ ( )

( ) ไม่มีกฎหมาย/ระเบียบบังคับ ( ) เรือมีพื้นที่มากพอเพื่อเก็บขยะ ( ) ท่านมีบริการทางเลือกอื่นๆ

( ) ทำให้เรือเกิดความล่าช้า ( ) ค่าบริการแพงเกินไป ( ) อื่นๆ.....

10 ท่านต้องการสร้างความร่วมมือในการพัฒนาการเก็บขยะจากเรือสินค้ากับท่าเรือแหลมฉบังหรือไม่

☐ ต้องการ ☐ ไม่ต้องการ เพราะ.....

11 หากท่านตอบ "ต้องการ" ในข้อ 10 ท่านต้องการสร้างความร่วมมือเพื่อพัฒนาในเรื่องใด โปรดเรียงลำดับความต้องการจากมากไปน้อย (1-6) ลงในวงเล็บ ( )

( ) เพื่อพัฒนาแบบฟอร์มเอกสารคำร้องเพื่อขอใช้บริการเก็บขยะจากเรือของท่าเรือแหลมฉบัง

( ) เพื่อพัฒนาวิธีการติดต่อเพื่อขอใช้บริการเก็บขยะจากเรือ/กระบวนการและเทคโนโลยีที่ใช้ในการเก็บขยะจากเรือของท่าเรือแหลมฉบัง

( ) เพื่อพัฒนาหลักสูตรการฝึกอบรม/การวิจัย/โครงการต่างๆเกี่ยวกับการจัดการขยะจากเรือของท่าเรือแหลมฉบัง

( ) เพื่อพัฒนาการวางแผน/การกำหนดนโยบายและระเบียบข้อบังคับเกี่ยวกับการทิ้งขยะจากเรือของท่าเรือแหลมฉบัง

( ) เพื่อพัฒนาการใช้ฐานข้อมูล (Database) เกี่ยวกับขยะจากเรือร่วมกันกับท่าเรือแหลมฉบัง

( ) อื่นๆ.....

12 ข้อเสนอแนะของท่านเกี่ยวกับขยะจากเรือ/การจัดการ/การติดต่อสื่อสาร ฯลฯ ของท่าเรือแหลมฉบัง

1 .....

2 .....

3 .....

4 .....

5 .....

Questionnaire part 2

ข้อที่	ท่านเห็นด้วยกับข้อความต่อไปนี้ในระดับใด	ไม่เห็นด้วยอย่างมาก	ไม่เห็นด้วย	ไม่แน่ใจ	เห็นด้วย	เห็นด้วยอย่างมาก
อุปกรณ์รองรับขยะจากเรือ						
1	รถเก็บขยะของท่าเรือแหลมฉบังสามารถเก็บขยะทั่วไปจากเรือของท่านได้ทั้งหมด					
2	รถเก็บขยะของท่าเรือแหลมฉบังสามารถเก็บขยะอันตรายจากเรือของท่านได้ทั้งหมด					
3	รถเก็บขยะของท่าเรือแหลมฉบังพร้อมให้บริการทุกครั้งที่ท่านต้องการ					
4	ท่านต้องนำขยะจากเรือไปทิ้งที่ถังขยะ/โรงคัดแยกขยะในท่าเรือแหลมฉบังด้วยตัวท่านเอง					
การให้บริการเก็บขยะของท่าเรือแหลมฉบัง						
5	ท่าเรือแหลมฉบังเก็บขยะทั่วไปอย่างรวดเร็ว ไม่ก่อให้เกิดความล่าช้ากับเรือของท่าน					
6	ท่าเรือแหลมฉบังเก็บขยะอันตรายในวัน/เวลา/สถานที่ที่ตกลงไว้กับท่าน					
7	อุปกรณ์ และวิธีการเก็บขยะของท่าเรือแหลมฉบังไม่ก่อให้เกิดปัญหามลพิษอื่นๆ					
ขั้นตอนและวิธีการติดต่อสื่อสารเพื่อขอใช้บริการเก็บขยะของท่าเรือแหลมฉบัง						
8	ขั้นตอนในการขอใช้บริการเก็บขยะไม่ซับซ้อนจนทำให้เกิดความยุ่งยากในการทำงานของท่าน					
9	เอกสารคำร้องขอใช้บริการเก็บขยะเป็นแบบฟอร์มที่ง่ายต่อการกรอกข้อมูล					
10	ท่านต้องการส่งเอกสารคำร้องขอใช้บริการเก็บขยะทางอิเล็กทรอนิกส์มากกว่าการใช้กระดาษ					
ค่าใช้จ่ายในการเก็บขยะ						
11	ท่านคิดว่าค่าเก็บขยะจากเรืออเนกประสงค์/ตู้สินค้า/ชายฝั่ง 150 บาท/ลำ/วัน ไม่แพงเกินไปและท่านยินดีจ่าย					
12	ท่านคิดว่าค่าเก็บขยะจากเรือสินค้าเทกอง 500 บาท/ลำ/วัน ไม่แพงเกินไปและท่านยินดีจ่าย					
13	ท่านคิดว่าค่าเก็บขยะจากเรือ ณ ที่ทอดสมอ 2,000 บาท/ลำ/เที่ยว ไม่แพงเกินไปและท่านยินดีจ่าย					
14	ท่าเรือแหลมฉบังควรเก็บค่าบริการเก็บขยะจากเรือทุกลำที่เข้าเทียบท่า ไม่ว่าเรือดังกล่าวจะใช้บริการเก็บขยะหรือไม่ โดยไม่ต้องคำนึงว่าเรือลำดังกล่าวจะยินดีจ่ายหรือไม่					
15	เรือที่ไม่ใช้บริการเก็บขยะ ไม่สมควรถูกเก็บค่าบริการ ดังนั้นท่าเรือแหลมฉบังควรเก็บจากเรือที่ใช้บริการเท่านั้น					
สถานที่ให้บริการเก็บขยะ						
16	สถานที่ติดต่อกับท่าเรือแหลมฉบังเพื่อขอใช้บริการเก็บขยะตั้งในที่ที่สังเกตเห็นได้ง่ายและสะดวกในการติดต่อขอใช้บริการ					
17	ท่านคิดว่าสถานที่ตั้งของจุดรับบริการเก็บขยะทำให้เกิดความล่าช้าในการเก็บขยะและการปฏิบัติงานของเรือ					
18	หากท่านรู้ว่าจุดให้บริการอยู่ที่ใดหรือหากจุดให้บริการอยู่ในที่ที่ติดต่อได้ง่ายจะทำให้การเก็บขยะเสร็จเร็วขึ้น					
การเข้าถึงข้อมูลบริการเก็บขยะ						
19	ท่านสามารถเข้าถึงข้อมูลบริการเก็บขยะของท่าเรือแหลมฉบังได้โดยง่ายและสะดวก					

ข้อที่	ท่านเห็นด้วยกับข้อความต่อไปนี้ในระดับใด	ไม่เห็นด้วยอย่างมาก	ไม่เห็นด้วย	ไม่แน่ใจ	เห็นด้วย	เห็นด้วยอย่างมาก
20	เมื่อท่านศึกษาข้อมูลเกี่ยวกับบริการเก็บขยะมากพอแล้ว ท่านจึงตัดสินใจใช้บริการเก็บขยะ					
21	ท่านทราบดีว่า ท่านสามารถเข้าถึงข้อมูลบริการเก็บขยะของท่าเรือแหลมฉบังได้จากที่ใด					

Questionnaire part 3

ข้อที่	ท่านเห็นด้วยกับเหตุผลที่ทำให้ท่านต้องใช้บริการเก็บขยะจากเรือของท่าเรือแหลมฉบังในระดับใด	ไม่เห็นด้วยอย่างมาก	ไม่เห็นด้วย	ไม่แน่ใจ	เห็นด้วย	เห็นด้วยอย่างมาก
กฎหมายและระเบียบข้อบังคับ						
1	เพื่อปฏิบัติตามบทบัญญัติของอนุสัญญา MARPOL 73/78					
3	กรมเจ้าท่าในฐานะรัฐเจ้าของธง บังคับท่านให้ใช้อุปกรณ์/บริการเก็บขยะจากเรือ					
4	กรมเจ้าท่าในฐานะรัฐเมืองท่า บังคับให้ท่านต้องใช้บริการ					
5	ท่าเรือแหลมฉบังมีกฎระเบียบด้านการทิ้งขยะที่เข้มงวดและบังคับให้เรือทุกลำที่เข้าเทียบท่าต้องใช้บริการเก็บขยะ					
6	รัฐเจ้าของธงต่างชาติบังคับให้ท่านใช้อุปกรณ์เก็บขยะจากเรือของท่าเรือแหลมฉบัง					
ข้อจำกัดของเรือและปัจจัยอื่นๆในการเดินทาง						
7	เพราะท่าเรือแหลมฉบังเป็นท่าเรือปลายทางพอดี (Destination port)					
8	เพราะพื้นที่เก็บขยะบนเรือไม่เพียงพอสำหรับขยะที่จะเกิดขึ้นระหว่างการเดินทางต่อไปยังท่าเรือถัดไป					
9	เพราะท่าเรือถัดไปไม่มีอุปกรณ์หรือบริการเก็บขยะจากเรือและมักมีปัญหาอื่นๆในการให้บริการ					
10	เพราะท่าเรือถัดไป (Next port) คิดค่าบริการเก็บขยะจากเรือแพงเกินไป					
11	เพราะท่าเรือก่อนหน้าท่าเรือแหลมฉบัง (Previous port) ไม่มีอุปกรณ์และคิดค่าบริการเก็บขยะแพงเกินไป					
12	ท่านไม่ใช้บริการเก็บขยะของท่าเรือแหลมฉบังเพราะบนเรือมีปริมาณขยะน้อยและมีพื้นที่เหลือเพียงพอ					
13	เพราะท่านไม่มีทางเลือกอื่น นอกจากบริการของท่าเรือแหลมฉบัง					
นโยบายและผลกระทบต่อผลประกอบการของบริษัท						
14	เพราะบริษัทของท่านกำหนดให้เรือทิ้งขยะทุกท่าที่แวะจอดบรรทุกหรือขนถ่ายสินค้า					
15	เพราะบริษัทของท่านมีนโยบาย/สัญญาระยะยาวในการใช้อุปกรณ์เก็บขยะกับท่าเรือแหลมฉบัง					
16	เพราะบริษัทของท่านมีสัญญาระยะยาวในการใช้อุปกรณ์เก็บขยะกับผู้ประกอบการอื่นในประเทศไทย					
17	เพราะการใช้บริการเก็บขยะของท่าเรือแหลมฉบังช่วยลดต้นทุนและระยะเวลาจอดเรือในท่าได้มาก					
18	บริษัทมอบอำนาจให้แก่กัปตันเรือ/ตัวแทนเรือในการตัดสินใจว่าจะใช้บริการเก็บขยะจากเรือหรือไม่					
ความพึงพอใจต่อการให้บริการของท่าเรือแหลมฉบัง						
19	เพราะท่าเรือแหลมฉบังสามารถเก็บขยะได้ทุกชนิด ในปริมาณไม่จำกัด					
20	เพราะท่าเรือแหลมฉบังเก็บขยะโดยไม่ทำให้เกิดความล่าช้าหรือการรอคอยใดๆแก่เรือ					

ข้อที่	ท่านเห็นด้วยกับเหตุผลที่ทำให้ท่านต้องใช้บริการเก็บขยะจากเรือของท่าเรือแหลมฉบังในระดับใด	ไม่เห็นด้วยอย่างมาก	ไม่เห็นด้วย	ไม่แน่ใจ	เห็นด้วย	เห็นด้วยอย่างมาก
21	เพราะติดต่อได้สะดวก มีขั้นตอนการใช้บริการที่ง่าย และสามารถเปลี่ยนแปลงคำขอใช้บริการได้					
22	เพราะท่าเรือแหลมฉบังเก็บค่าใช้จ่ายจากการใช้บริการด้วยราคาที่สมเหตุสมผล					
23	เพราะท่านได้รับสิทธิประโยชน์อื่นๆจากท่าเรือแหลมฉบัง					
ท่านเห็นด้วยกับข้อความต่อไปนี้ในระดับใด						
24	เรือของท่านเป็นส่วนหนึ่งที่ทำให้เกิดมลพิษทางทะเล					
25	หน่วยงานภาครัฐมีหน้าที่ดูแล ป้องกันมลพิษจากขยะจากเรือ					
26	การป้องกันมลพิษทางทะเลเป็นหน้าที่พื้นฐานของผู้ขนส่งทางทะเล					
27	การนำขยะมาทิ้งที่ท่าเรือทำให้เรือสินค้าเสียเวลา และค่าใช้จ่ายโดยไม่จำเป็น					
28	ขยะที่เกิดจากเรือเป็นของเสียอันตรายที่ก่อให้เกิดมลพิษทางทะเลได้ ซึ่งเป็นภัยต่อสิ่งมีชีวิตในทะเล และมนุษย์					
29	ท่านยินดีนำขยะมาทิ้งที่ท่าเรือเพื่อเป็นการช่วยป้องกัน และรักษาสิ่งแวดล้อมทางทะเล					
30	อุปกรณ์และบริการเก็บขยะจากเรือเป็นปัจจัยที่จะช่วยป้องกันปัญหามลพิษทางทะเลได้					

Questionnaire part 4

ข้อที่	กระบวนการเก็บขยะจากเรือในปัจจุบันตรงกับข้อความต่อไปนี้ในระดับใด	ไม่เห็นด้วยอย่างมาก	ไม่เห็นด้วย	ไม่แน่ใจ	เห็นด้วย	เห็นด้วยอย่างมาก
1	ท่านติดต่อกับท่าเรือแหลมฉบังเมื่อต้องการใช้บริการเก็บขยะจากเรือเท่านั้น					
2	ท่านส่งเอกสารที่ใช้ติดต่อกับท่าเรือแหลมฉบังด้วยระบบ Manual เป็นส่วนใหญ่					
3	ท่าเรือแหลมฉบังปรับปรุงกระบวนการติดต่อสื่อสารเพื่อเพิ่มประสิทธิภาพอย่างสม่ำเสมอ					
4	ท่านพยายามลดต้นทุนที่เกิดจากการเก็บขยะจากเรือ เพื่อลดต้นทุนรวมของบริษัท					
5	ท่านใช้บุคคลในการยื่นเอกสารขอใช้บริการเก็บขยะจากท่าเรือแหลมฉบัง					
6	ขั้นตอนและวิธีการแจ้งคำขอใช้บริการเก็บขยะจากเรือถูกกำหนดโดยท่าเรือแหลมฉบัง					
7	ท่านปรับปรุงระบบติดต่อสื่อสารกับท่าเรือแหลมฉบังเพื่อลดระยะเวลาการเก็บขยะจากเรือของท่าน					
8	ท่านออกแบบและปรับปรุงแบบฟอร์มเอกสารต่างๆร่วมกันกับท่าเรือแหลมฉบัง					
9	ท่านและท่าเรือแหลมฉบังใช้แบบฟอร์มมาตรฐานเดียวกันทำให้ระยะเวลาและต้นทุนของการเก็บขยะลดลง					
10	ท่าเรือแหลมฉบังให้ข้อมูลที่เป็นประโยชน์ต่อการวางแผนขนถ่ายขยะจากเรือแก่บริษัทของท่าน					
11	ท่านแจ้งข้อมูลขอใช้บริการเก็บขยะล่วงหน้า 24 ชั่วโมงก่อนเรือเข้าเทียบท่า					
12	การแจ้งข้อมูลล่วงหน้าช่วยเพิ่มประสิทธิภาพในการวางแผนการขนถ่ายขยะให้ดีขึ้น					
13	ท่านสามารถดาวน์โหลดเอกสาร/ข้อมูลเกี่ยวกับบริการเก็บขยะของท่าเรือแหลมฉบังได้สะดวกและรวดเร็ว					

ข้อที่	กระบวนการเก็บขยะจากเรือในปัจจุบันตรงกับข้อความต่อไปนี้ในระดับใด	ไม่เห็นด้วยอย่างมาก	ไม่เห็นด้วย	ไม่แน่ใจ	เห็นด้วย	เห็นด้วยอย่างมาก
14	ท่านใช้ระบบ EDI, Intranet หรือ Internet ในการแจ้งคำขอใช้บริการเก็บขยะจากท่าเรือแหลมฉบัง					
15	ท่านคิดว่าเรือจะไม่เกิดความล่าช้า ถ้าหากท่าเรือแหลมฉบังเก็บขยะเสร็จทันการบรรทุกหรือขนถ่ายสินค้า					
16	ท่าเรือแหลมฉบังช่วยท่านพัฒนากระบวนการติดต่อสื่อสารเทคโนโลยี และการเก็บขยะจากเรือ					
17	ท่านทราบแผนและขั้นตอนการขนถ่ายขยะอย่างชัดเจน เพราะท่าเรือแหลมฉบังแจ้งท่านอย่างสม่ำเสมอ					
18	ท่านกำหนดให้แผนงานของบริษัทมีความสอดคล้องกับแผนงานของท่าเรือแหลมฉบัง					
19	การพัฒนากระบวนการเก็บขยะร่วมกันช่วยลดต้นทุนและระยะเวลาในการปฏิบัติการเรือได้					
20	ท่านเจรจา/ต่อรอง/ปรึกษากับท่าเรือแหลมฉบังบ่อยครั้งเพื่อปรับปรุงกระบวนการเก็บขยะจากเรือ					
21	ท่าเรือแหลมฉบังรับฟังปัญหาการขนถ่ายขยะจากเรือของท่าน และรีบแก้ไขโดยทันที					
22	ท่านและท่าเรือแหลมฉบังมีการจัดอบรมหลักสูตรระยะสั้น/งานวิจัย/โครงการระยะสั้นที่เกี่ยวกับขยะร่วมกัน					
23	ท่านคิดว่าการสร้างความร่วมมือระหว่างกันทำให้เกิดองค์ความรู้ใหม่ซึ่งช่วยพัฒนาขีดความสามารถขององค์กร					
24	ท่าน ท่าเรือแหลมฉบังและผู้ประกอบการอื่นๆร่วมกันวางแผนและกำหนดนโยบายการเก็บขยะจากเรือ					
25	ท่าเรือแหลมฉบังใช้อุปกรณ์ในการเก็บขยะจากเรือที่ได้รับความเห็นชอบจากท่านและผู้ประกอบการอื่นๆ					
26	ท่านคิดว่าการวางแผนร่วมกันจะช่วยให้การบริการเก็บขยะจากเรือมีประสิทธิภาพมากขึ้นซึ่งเป็นผลดีกับทุกฝ่าย					
27	ท่านพัฒนา/ใช้ฐานข้อมูลและระบบสารสนเทศร่วมกันกับท่าเรือแหลมฉบังและผู้ขนส่งทางทะเลอื่นๆ					
28	ท่านคิดว่าการใช้ข้อมูลและระบบสารสนเทศเดียวกันช่วยเพิ่มความแม่นยำในการวางแผนและการพยากรณ์ได้					
29	ท่านและท่าเรือแหลมฉบังเข้าใจและคำนึงถึงผลประโยชน์ของกันและกันมากกว่าผลประโยชน์ส่วนตน					
30	การไม่มีความร่วมมือระหว่างกันจะลดความสามารถในการแข่งขันของท่าเรือและผู้ขนส่งทางทะเล					
31	ความร่วมมือในการวางแผน และการปรับปรุงกระบวนการเก็บขยะจากเรือจะช่วยเพิ่มความสามารถในการป้องกันมลพิษทางทะเลได้					

VITA

After completing the Bachelor of Science in Maritime Industrial Management from Burapha University with the First Class and Gold Medal Honors in 2009, Acting Sub Lieutenant Chalermpong Senarak initiated his career as the visiting lecturer at the Faculty of Logistics, Burapha University. At the same time, he attended his master degree in Maritime Administration (MARAD) of the Graduate School, Chulalongkorn University. After spending one and half years at MARAD, he completed his master degree in 2011. Two years later, he began his new job as the curriculum lecturer in Maritime Transportation Program at the Faculty of International Maritime Studies (IMS), Kasetsart University Sriracha Campus. In 2014 at IMS, he was granted with full scholarship to pursue Ph.D. study in Logistics Management at Chulalongkorn University. His dissertation is "AN ADOPTION OF MARPOL 73/78 FOR MANAGING SHIP-GENERATED GARBAGE IN LAEM CHABANG PORT : A CASE OF SHIPPING COLLABORATIONS" which was selected as the outstanding doctoral research for presenting in the celebrating ceremony 100 Years of Chulalongkorn University in 2017. With the considerable attempt under the supervision of Prof. Kamonchanok Suthiwartnarueput, he spent only two and half years in accomplishing his Ph.D. and continue his researching and teaching life in maritime transportation, cargo transport management and port management at IMS.